

167468



**Groundwater Monitoring Plan
For Time Critical Removal Action
Dead Creek Sediments and Soils
TSCA Containment Cell
Cahokia, Illinois**

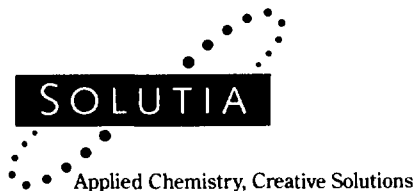
Prepared For:

**Solutia, Inc.
575 Maryville Centre Drive
St. Louis, Missouri 63141**

By:

**R. S. Williams & Associates Inc.
984 Creekside Circle
Naperville, IL 60563**

**Revision 1
August 2001**



Solutia Inc.

575 Maryville Centre Drive
St. Louis, Missouri 63141

P.O. Box 66760
St. Louis, Missouri 63166-6760
Tel/ 314-674-1000

August 3, 2001

Kevin Turner-Environmental Scientist, OSC
U. S. Environmental Protection Agency
c/o Crab Orchard National Wildlife Refuge
8588 Rt. 148
Marion, IL 62959

Re: Sauget Sites Area I - May 31, 2000 Unilateral Administrative Order (UAO)
Sediment / Soils Removal Action
• **Groundwater Monitoring Plan – Revision I**

Dear Mr. Turner,

Pursuant to the United States Environmental Protection Agency ("USEPA") Sauget Sites Area I May 31, 2000 Unilateral Administrative Order ("UAO"), issued to Solutia Inc. and Monsanto (Solutia Inc. and Monsanto are hereinafter referred to as "Solutia"), Section V. **Order**, 3. Work to be Performed, 6. Containment Cell Design Report Requirements, D) Operations and Maintenance Plan, requiring Respondents to submit a Groundwater Monitoring Plan, Revision I of said plan is hereby submitted for Agencies' review and approval.

Sincerely,

A handwritten signature in black ink, appearing to read "D. M. Light", is written over a horizontal line.

D. M. Light
Manager, Remedial Projects

cc: (w/enclosure)

Thomas Martin, Esq. - USEPA
Michael McAteer - USEPA
Sandra Bron - IEPA
Linda Tape, Esq. - Thompson Coburn

TABLE OF CONTENTS

1	Introduction – 703.185, 724.190(b)	1
2	Purpose – 703.135(f)(4), 724.197(d), 724.197(e).....	3
3	Site Features – 703.185(c).....	4
3.1	Land Use	4
3.2	Climate	5
3.3	Geographic Setting.....	7
3.4	Drainage and Hydrology	7
4	Geology and Hydrogeology – 703.185(b), 620.210	11
4.1	Regional Geology	11
4.2	Regional Hydrogeology	13
4.3	Site Geology and Hydrogeology.....	18
4.4	Aquifer Classification	20
5	Existing Groundwater Quality - 703.185(a), 703.185(d), 721 App. I.....	21
5.1	Interim Status Monitoring	21
5.2	Results of Previous Investigations	21
5.3	Volatile Organic Compounds	21
5.4	Semi Volatile Organic Compounds	22
6	Groundwater Monitoring System – 703.185(e), 703.185(f), 724.197, 724.198.....	24
6.1	Groundwater Monitoring System.....	24
6.2	Proposed Point of Compliance	24
6.3	Well Construction	25
6.4	Well Replacement.....	25

TABLE OF CONTENTS

6.5	Sampling and Analysis Procedures	25
6.6	Background Groundwater Quality	26
6.7	Sampling Frequency	27
6.8	Indicator Parameters	27
6.9	Statistical Analyses	29
6.10	Reports	30

LIST OF FIGURES

Figure 1-1: Dead Creek Site Location	2
Figure 3-1: Land Use within the Site Vicinity	6
Figure 3-2: Physiographic Regions of Illinois.....	10
Figure 4-1: Generalized Geologic Column for South-Central Illinois.....	14
Figure 4-2: Thickness of the Unconsolidated Valley Fill in the Project Area.....	15
Figure 4-3: Cross Section of the Valley Fill in the Vicinity of the Project Area.....	16

LIST OF TABLES

Table 1 – Groundwater Quality Regulatory Exceedances
Table 2 – Constituents Detected in Sediment, Maximum Historical Results
Table 3 – Constituents Detected in Sediment, Site Sampling Plan Results

LIST OF DRAWINGS

Drawing 1	Boring Location Plan
Drawing 2	Subsurface Profile
Drawing 3	Support Sampling Plan Groundwater Sampling Locations
Drawing 4	Monitoring Well Locations
Drawing 5	Groundwater Monitoring Well Near-Cell Location Plan
Drawing 6	Groundwater Monitoring Well Detail
Drawing 7	Flow Chart Depicting Sampling Data Evaluation Algorithm

TABLE OF CONTENTS

LIST OF APPENDICES

Appendix A – Boring Logs
Appendix B – Piezometric Surface Maps
Appendix C – ASTM Standard D-6312-98

**Time Critical Removal Action
Dead Creek Sediments and Soils
Containment Cell Groundwater Monitoring Plan
Revision 1**

August 3, 2001

1 INTRODUCTION – 703.185, 724.190(b)

The following presents a Groundwater Monitoring Plan (GMP) for implementation of groundwater monitoring activities at the proposed Toxic Substances Control Act (TSCA) Landfill Cell in Cahokia, Illinois. This cell is being constructed in partial fulfillment of a Unilateral Administrative Order (Order) issued by the United States Environmental Protection Agency (USEPA) to Solutia Inc. The Order requires a Time Critical Removal Action for sediments and soils in portions of Dead Creek in Sauget, Illinois (Figure 1-1). The cell will be used to contain the excavated materials.

The containment cell will be about 3 acres in size and located on the Solutia, Inc. property formerly known as the Moto property. The cell will be bordered on the north by Site G, a former subsurface/surface disposal area of about 4.5 acres size, and on the east by Dead Creek.

The cell does not qualify for an exemption from groundwater protection requirements under 35 IAC 703.185 and 724.190(b). Consequently, Solutia will operate and maintain a groundwater monitoring system capable of detecting statistically significant changes in groundwater quality occurring as a result of potential releases from the facility.

703.185
724.190(b)

August 3, 2001

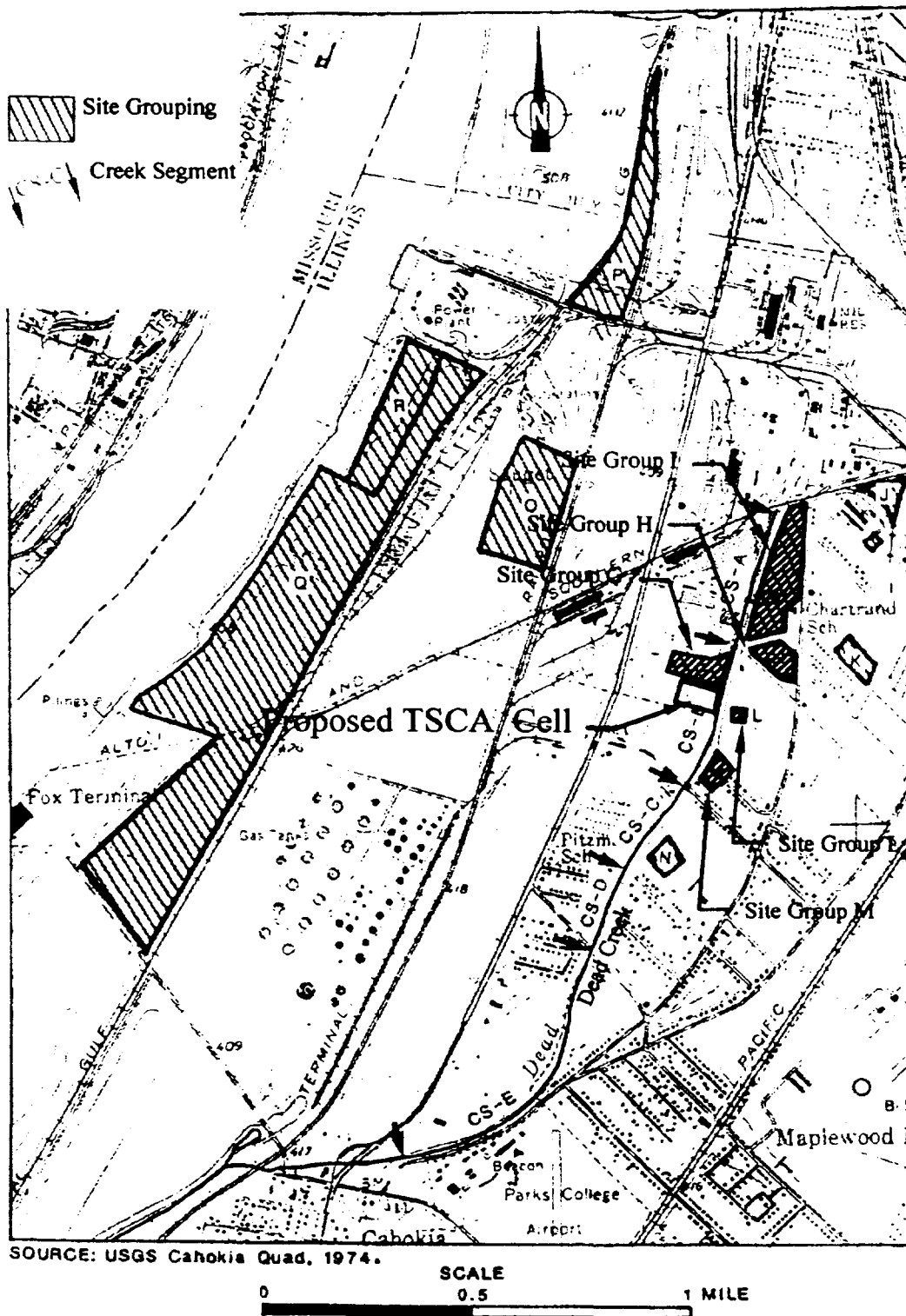


Figure 1-1: Dead Creek Site Location

2 PURPOSE – 703.135(f)(4), 724.197(d), 724.197(e)

This GMP for the containment cell has been developed in substantial compliance with applicable Illinois regulations. The purpose of the GMP is to provide a framework for the development of a monitoring well network and consistent collection of groundwater samples, which are verifiable and representative of the site's groundwater conditions. Adherence to a standardized protocol for sample collection, management and analysis procedures will allow collected data to be comparable over time.

Specific procedures for groundwater sample collection, water level measurement, sample preservation and handling, chain of custody procedures, and analysis of samples collected at the site will be the same as those used during the performance of an Engineering Evaluation/Cost Analysis (EE/CA) and a Remedial Investigation/Feasibility Study (RI/FS) which were both recently completed by Solutia in the general site area. The Field Sampling and the Quality Assurance Project Plans were reviewed by the Illinois Environmental Protection Agency (IEPA) and were approved by USEPA on September 9, 1999 . Thus, those plans satisfy the requirements of 35 IAC 703.185(f)(4), 724.197(d), and 724.197(e) and are incorporated into this GMP by reference. All sampling and analysis of groundwater from the site will be performed in strict accordance with the procedures and methods outlined in these plans. All personnel involved in groundwater sampling at the containment cell must review and become familiar with the requirements of the plans.

703.185(f)(4)
724.197(d)
724.197(e)

3 SITE FEATURES – 703.185(c)

3.1 Land Use

Heavy industry has located on the east bank of the Mississippi River between Cahokia and Alton, Illinois for nearly a century. Industrial activity peaked in the 1960s and although heavy industry has shut down throughout the American Bottoms, the Sauget area is still highly industrialized. In addition to heavy industry, the area currently has warehouses, trucking companies, commercial facilities, bars, nightclubs, convenience stores and restaurants. The wide variety of land utilization in the vicinity of the proposed containment cell area is shown on Figure 3-1. Over 50 percent of the land usage in the town of Sauget is industrial.. The land use in Cahokia is mostly residential, commercial and agricultural.

Active and inactive industrial facilities are located upgradient of the site (Mobil, Sterling Steel, T. J. Moss). Former industrial facilities (Midwest Rubber and Darling Fertilizer), bulk storage areas (Eagle Marine and Slay Terminals), waste disposal areas (Sauget Area 2 Sites Q and R), waste treatment facilities (Trade Waste Incineration), a chemical reprocessor (Resource Recovery Group), closed sludge lagoons (Sauget Area 2 Site O) and active waste-water treatment plants (P/Chem Plant and American Bottoms Regional Treatment Facility) are located downgradient of the general site area. Active industrial facilities in the area include Ethyl Corporation, Big River Zinc and Cerro Copper.

The property on which the proposed containment cell is located was most recently used for agricultural purposes. Immediately to the east, across Dead Creek, is the property of the Metro Construction Company, beyond which are Site H (a former subsurface disposal area), and Site L, the former location of a surface impoundment used by a bulk liquid transporter. A residential area is about 900 feet to the east. North of the proposed cell is Site G, a surface/subsurface disposal site whose western boundary roughly coincides with the west end of the Weise Engineering Company building. Going further north, across Queeny Avenue, is the industrial complex of Cerro Copper Products. Site I is located on

the eastern portion of the Cerro property. Other commercial enterprises are located to the west and south west of the proposed cell location. About $\frac{1}{2}$ to $\frac{3}{4}$ of a mile south across an agricultural area are the residences of northern Cahokia.

3.2 Climate

The climate of the study area is described by the National Climatic Data Center (NCDC) as a modified continental climate. The area is subject to four seasonal climate changes without the undue hardship of prolonged periods of extreme heat or high humidity. To the south is the warm, moist air of the Gulf of Mexico; and to the north, in Canada, is a region of cold air masses. The convergence of air masses from these sources, and the conflict on the frontal zones where they come together, produce a variety of weather conditions, none of which are likely to persist for any great length of time.

Winters are brisk and seldom severe. Records since 1870 show that the temperature drops to zero degrees Fahrenheit (0° F) or below on average two to three days per year. The area stays at or below 32° F for less than 25 days in most years. Average snowfall for the area is a little over 18 inches per winter season. Snowfall of an inch or more is received on five to ten days in most years. The long-term record for the St. Louis area (since 1870) indicates that temperatures of 90° F or higher occur on about 35 to 40 days per year, and extremely hot days of 100° F or more are expected no more than five days per year.

The normal annual precipitation for the area is slightly less than 34 inches. The winter months are the driest, with an average total of about 6 inches of precipitation. The spring months of March through May are normally the wettest, with normal precipitation of just under 10.5 inches.

Wind direction is typically from the northeast during the winter months and from the south to southwest during the summer. The mean annual wind velocity is 9.3 mph.

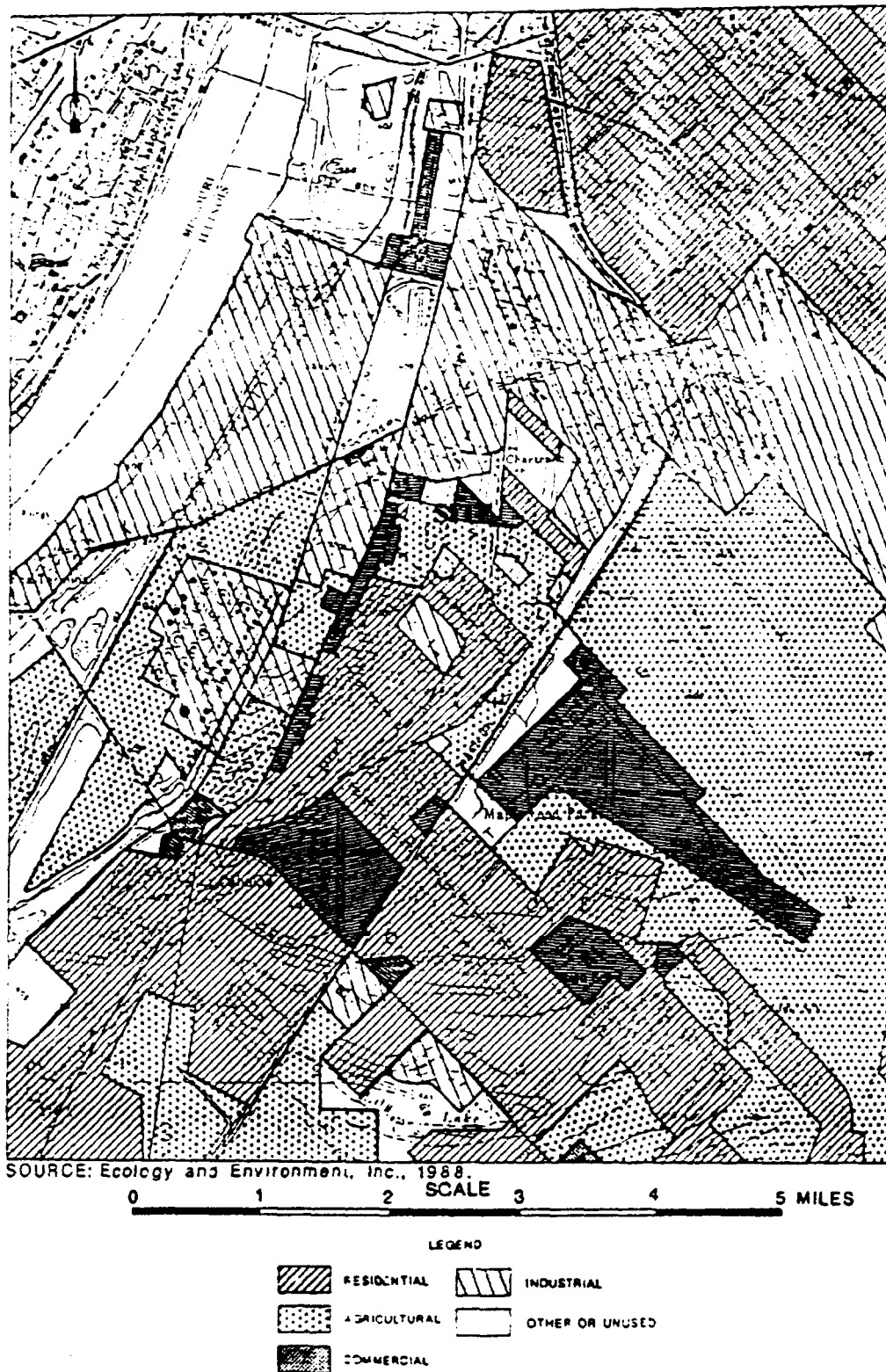


Figure 3-1: Land Use within the Site Vicinity

3.3 Geographic Setting

The site is situated in the far southwest portion of the Springfield Plain within the Till Plains Section of the Central Lowland Province of Illinois as shown on Figure 3-2. The basically flat Springfield Plain consists of Illinoian drift. The western boundary of the till plain is marked by morainic and flood plain features, including broad and flat swampy areas, terraces, curved ridges and swales, and crescent-shaped ox-bow lakes.

The area of the containment facility is situated in a floodplain of the Mississippi River called the American Bottoms. It is located on the eastern side of the river, directly opposite St. Louis, Missouri. As a whole, the floodplain encompasses 175 square miles, is 30 miles long, and has a maximum width of 11 miles. It is bordered on the west by the Mississippi River and on the east by bluffs that rise 150 to 200 feet above the valley bottom. The floodplain is relatively flat and generally slopes from north to south and from east to west. Land surface lies between 400 and 445 feet above mean sea level (MSL).

For the most part, the site topography at the containment facility site consists of nearly flat bottom land varying from elevation 405 to 407 feet above mean sea level (MSL). The site is dissected in its center, along the north south direction, by slightly lower terrain ranging from elevation 403 ft MSL in the south to about 400 ft MSL in the north. A detailed topographic map of the site is shown on Drawing No.1.

703.185(c)

3.4 Drainage and Hydrology

The Mississippi River, bordering the American Bottoms to the west, is the major surface-water body draining the area. It is fed by a complex network of natural and artificial channels which have undergone extensive improvement throughout the 20th Century. According to an investigation of ground-water resources conducted by the Illinois State Water Survey Division, at least 40 miles of improved drainage ditch have been

constructed and the natural lake area in the center of the floodplain has been reduced by more than 40 percent.

Dead Creek serves as the main conduit for surface-water drainage through the site area. The creek flows to a floodway south of Cahokia, which in turn discharges to the Cahokia Chute of the Mississippi River. Surface drainage across the area is generally toward Dead Creek, although specific drainage patterns are present in the general site area, as listed below:

- An emergency action response by the USEPA in 1995 resulted in the capping of Site G. Because of this, surface water flows radially away from the site.
- Drainage at Site H is typically toward Dead Creek, although the site contains several small depressions capable of retaining water. Water accumulating in these depressions due to precipitation infiltrates to ground rather than draining from the site across the surface.
- The majority of drainage at Site I is to the west. Water flows to an interceptor and is ultimately carried through a series of storm sewers and effluent pipes to the American Bottoms Regional Treatment Facility. Currently, stormwater runoff from the southern end of Site I drains to a catch basin on the north side of Queeny Avenue. This catch basin drains into CS-B.
- Drainage at Site L flows to the west toward the creek across a cover of highly permeable material (cinders).
- Site M is the recipient of surface runoff from a small residential area located to the southeast of the area. Surface water drains into Dead Creek through a cut-through located in the southwest corner of the site.
- Site N receives runoff from the surrounding area.

Flooding occurs in the general site area during periods of significant precipitation due to low topographic relief, lack of a storm-water drainage system in developed areas and limited hydraulic capacity in Dead Creek resulting from under-sized road culverts. During such events, surface-water runoff is unable to drain sufficiently to prevent

**Time Critical Removal Action
Dead Creek Sediments and Soils
Containment Cell Groundwater Monitoring Plan
Revision 1**

August 3, 2001

ponding and backup. The creek overflows at the same time that the banks and adjacent areas begin to flood due to lack of relief, resulting in flooding of the entire area.

Within the specific site area itself, surface water generally drains away from Dead Creek towards the west into a swale in the center of the site, where it infiltrates into the subsurface. Surface water from site G also flows toward the same swale.

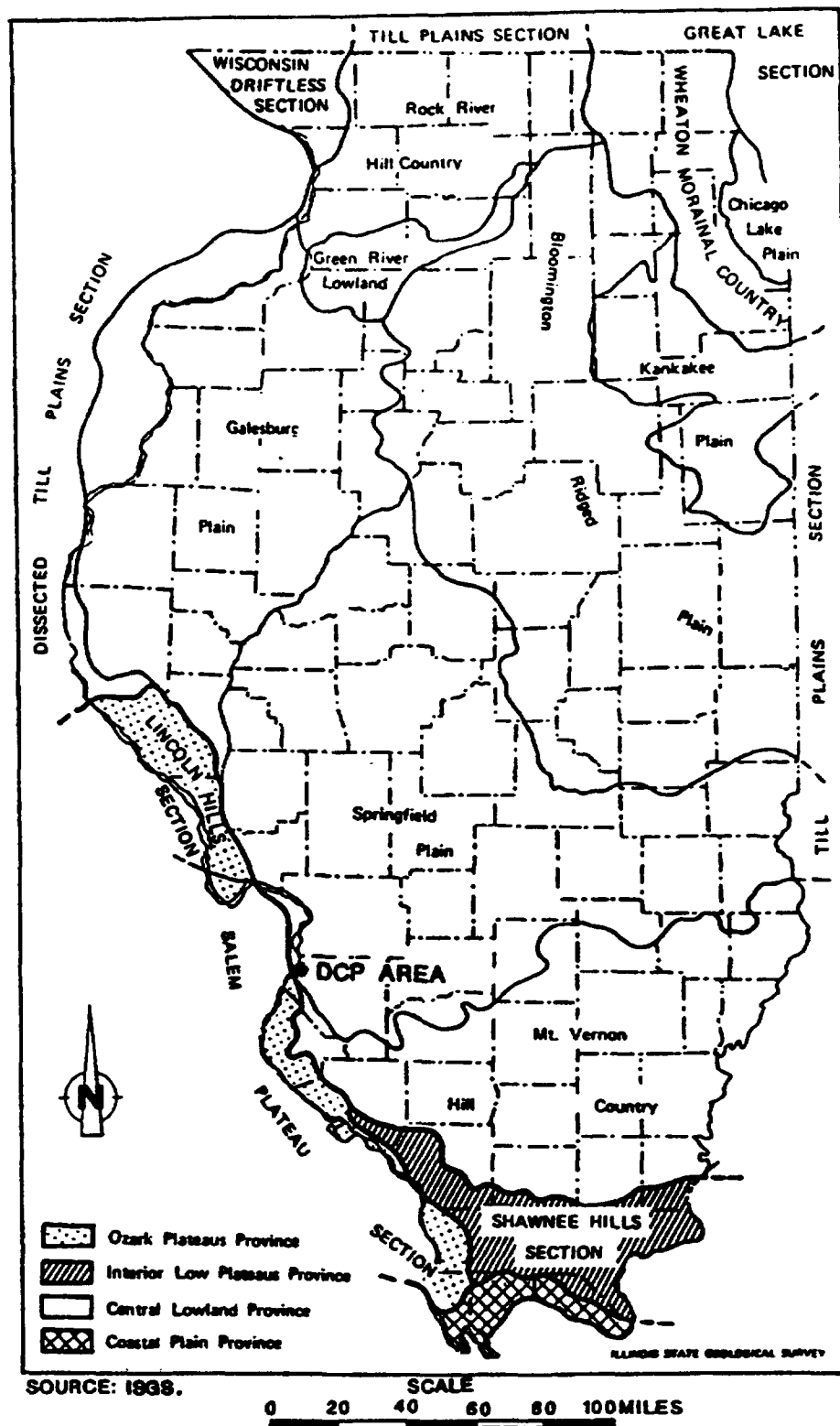


Figure 3-2 : Physiographic Regions of Illinois

4 GEOLOGY AND HYDROGEOLOGY – 703.185(b), 620.210

703.185(b)
620.210

Since previous investigations of the Dead Creek Project sites have extensively covered the regional geology and hydrogeology of the containment site, the following section is adapted from a report titled "Expanded Site Investigation, Dead Creek Project Sites at Cahokia/Sauget, Illinois, Final Report", May 1988, by Ecology and Environment, Inc.

4.1 Regional Geology

The geologic formations present in the project area consist of unconsolidated alluvium and glacial outwash, which are underlain by Mississippian and other bedrock layers. These bedrock layers are underlain by basement granitic crystalline rock. The geologic formation sequence for south-central Illinois is presented in Figure 4-1. The general site area, the American Bottoms, and the Mississippi River channels are all located in a broad, deeply cut bedrock valley. The bedrock valley is delineated by bluff lines on both sides. Based upon available data, the bedrock valley has steep walls along the bluffs, while the valley bottom slopes gently toward the middle of the valley.

Within the bedrock valley, the Mississippi River has provided the primary mechanisms controlling the recent formation of geology and hydrogeology. The Mississippi River and its valley were significantly modified and redesigned through both glacial and interglacial periods. These changes occurred as glacial wasting caused massive amounts of meltwater to be directed generally southward through and around bedrock and ice contacts, ultimately discharging into the Gulf of Mexico. Through geologic history, a wide and deep valley (2 to 8 miles across and up to 170 feet deep) has been carved into the predominantly soft sedimentary bedrock underlying the river. Changes in stream flow, direction, and sediment load have caused this valley to fill with secondary alluvial sediments. These constantly changing parameters have resulted in the river continuously picking up and depositing (and cutting and filling) its sediment base, thereby directing and redirecting the river and its channels through time.

The unconsolidated valley fill, present in the bedrock valley, ranges in thickness from approximately 70 to 120 feet in the study area. The thickness of the valley fill in the region of the study area is depicted in Figure 4-2. A cross-section of the valley fill in the vicinity of the study area is presented in Figure 4-3.

The valley fill deposits are typically composed of two main formations which may extend as deep as 120 feet in the project area. The Cahokia Alluvium, the uppermost formation, is predominantly composed of silt, clay, and fine sand deposits, generally indicative of an aggrading environment. These deposits were laid down as flood events of the Mississippi River, eolian activity, bank slumping, erosion, and/or slugs of material deposited directly by tributary streams. This formation has been frequently reworked by the Mississippi River and typically consists of coarser material inter-fingered with finer-grained deposits. As such, these deposits are variable in thickness (ranging from 15 to 30 feet). Larger expressions of tributary deposits may form thicker alluvial fans where high energy streams dissipated and dropped their sediment load.

The second major formation of the floodplain setting is the Mackinaw Member of the Henry Formation. This formation underlies the Cahokia Alluvium, and is composed of sand and gravel from glacial outwash. Within the site area, this material rests directly on the bedrock surface and can be highly variable in thickness (70 to 100 feet), due to the fluvial processes which formed it. This formation typically contains portions which are interbedded in complex ways due to meandering of the river throughout its history.

A third, minor formation noted locally within the floodplain, but not discovered within the site area, is the Peyton Colluvium. This material is composed of fine-grained silt (loess) and clay (till) which has slumped from upland areas and accumulated at the base of steep bluffs.

Immediately adjacent to the floodplain (and 3.5 to 5 miles east-southeast of the site) is an upland area marked by a steep bluff (50 to 150 feet above surrounding terrain).

Structurally, these upland areas are based unconformably on bedrock (which has not been eroded as deeply as the adjacent valley), and consist of 10 to 100 feet of unconsolidated sediments of predominantly glacial origin. No upland formations exist in the project area; however, erosion and slumping of the upland has provided the parent material for the Cahokia Formation and Peyton Colluvium, which are found in the floodplain.

The entire area is underlain by relatively soft sedimentary rock layers. Typically these rocks consist of shale, limestone, and sandstone. The earliest sedimentary rock overlying the granite basement rock is Cambrian-age sandstone, limestone, dolomite, and shale. The Ordovician system overlies the Cambrian deposits. Its formations also consist of sandstone, dolomite, limestone, and shale. Overlying the Ordovician is the Silurian System, consisting of numerous limestone layers. Next youngest is the Devonian System, with limestone, sandstone, and shale formations. At the top of the sequence is the Mississippian System containing numerous limestone, shale, siltstone, dolomite, and sandstone layers. Significant bedrock formations of the Mississippian System include the St. Genevieve and St. Louis limestones, which represent the bedrock surface below the project area. Although absent in the site area, the Pennsylvanian System is present in the adjacent highlands and at one bedrock high located within the valley south of the site area. This system contains various sandstones, siltstones, and shale formations.

4.2 Regional Hydrogeology

Groundwater in the project area exists in both the unconsolidated valley fill and the underlying Mississippian limestone and sandstone formations. Where these bedrock formations are located immediately below the unconsolidated material, sufficient groundwater is available for small or medium users. However, because of the abundance of groundwater in the valley fill sand and gravel, the bedrock aquifer is of little significance in the study area. The Illinois State Water Survey (ISWS) has identified the study area as one in which the chances of obtaining well yields of 500 gallons per minute (gpm) or more are good.

Time Critical Removal Action
Dead Creek Sediments and Soils
Containment Cell Groundwater Monitoring Plan
Revision 1

August 3, 2001

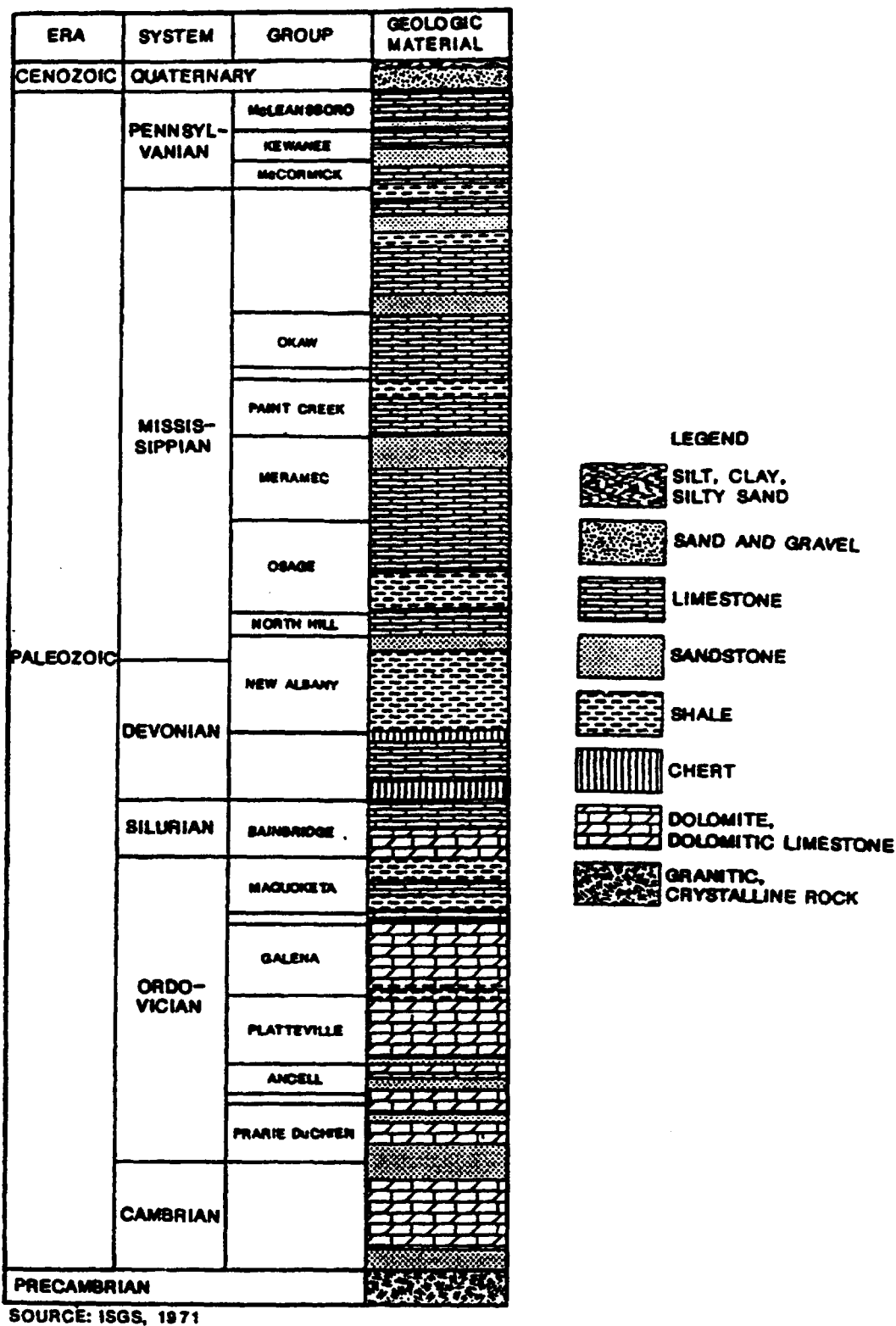


Figure 4-1: Generalized Geologic Column for South-Central Illinois

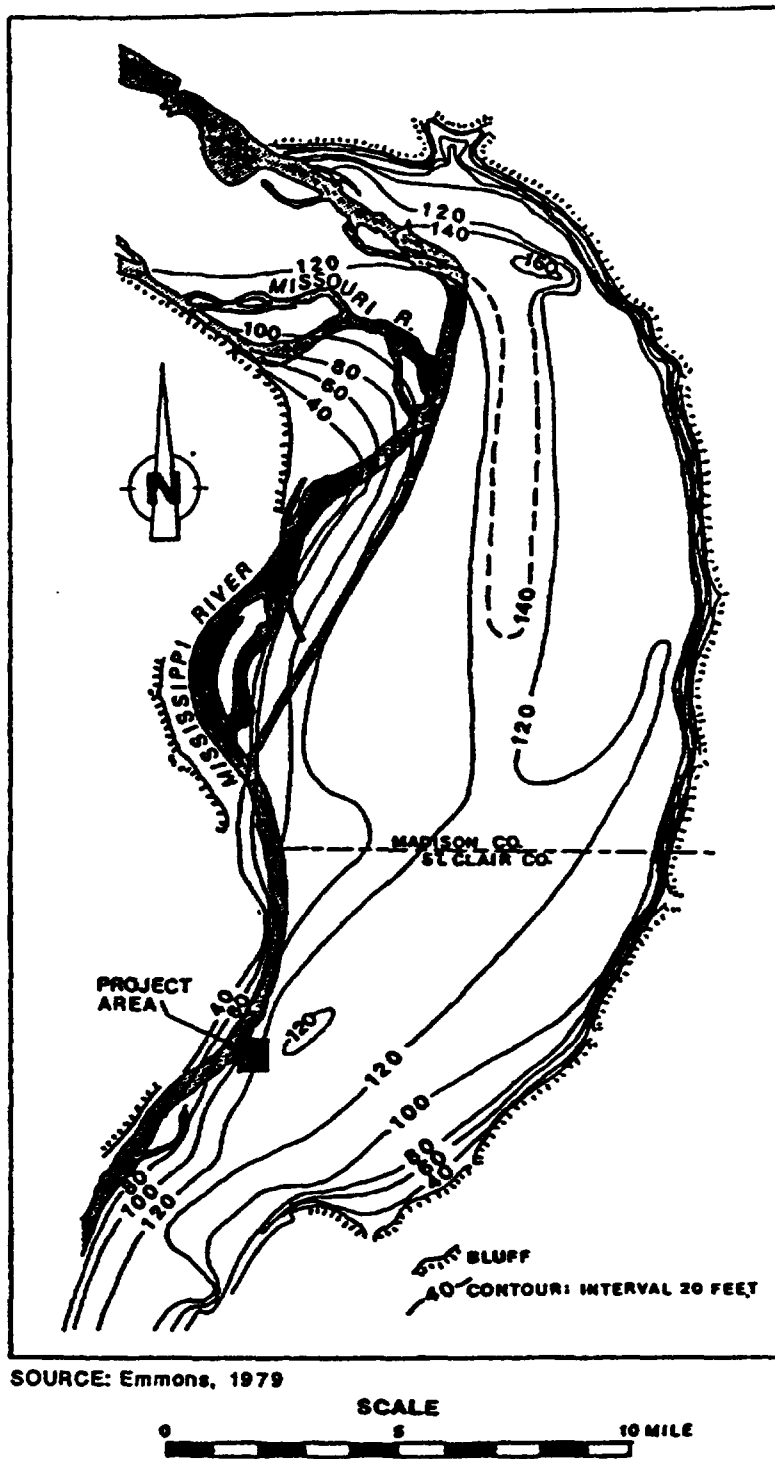


Figure 4-2: Thickness of the Unconsolidated Valley Fill in the Project Area

August 3, 2001

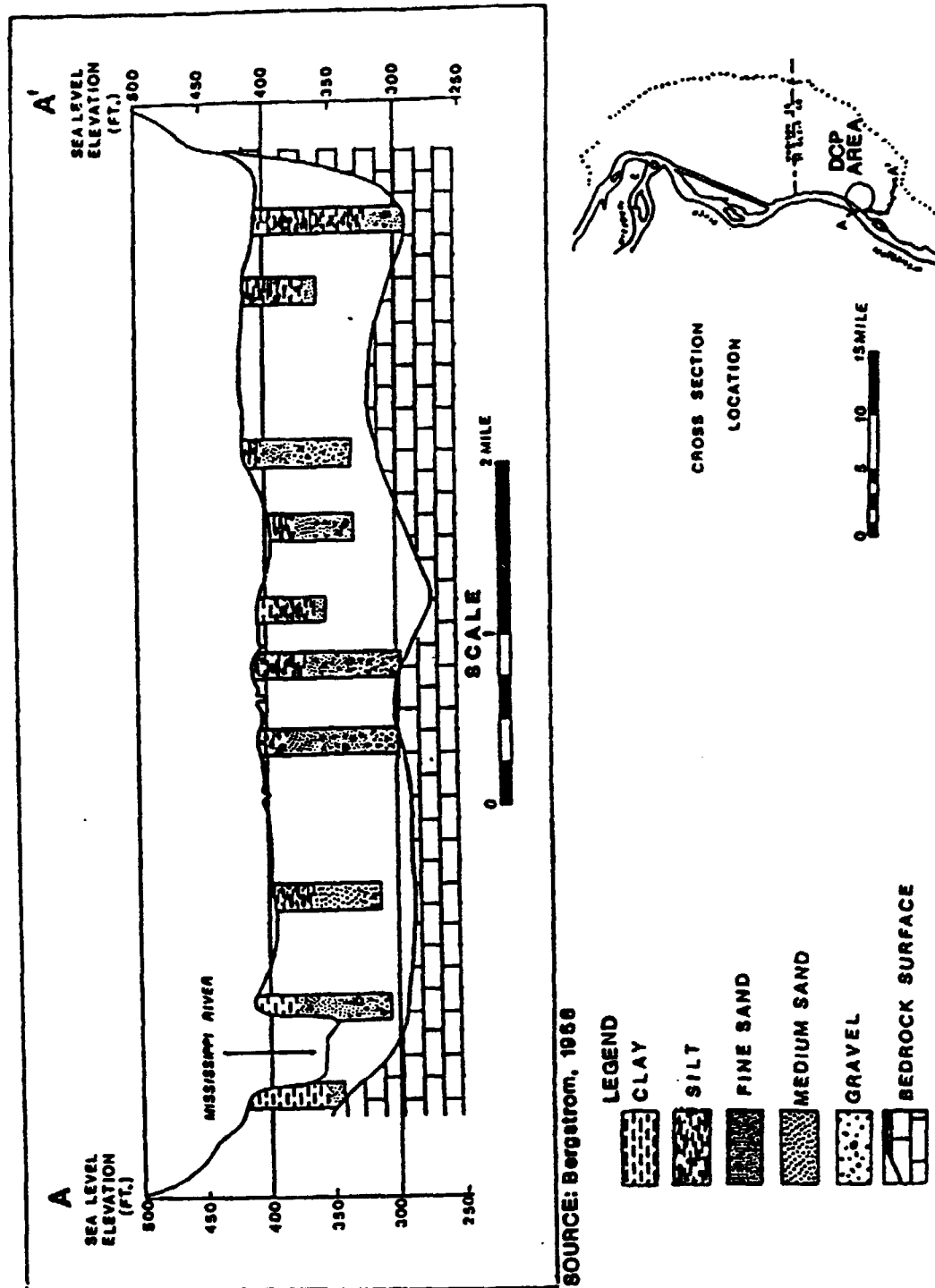


Figure 4-3: Cross-Section of the Valley Fill in the Vicinity of the Project Area

Geologic data show that the unconsolidated deposits range from 140 feet thick near the river to about 100 feet in the eastern part of the site area. At most locations, the contact between the Cahokia Alluvium and the Henry Formation cannot be distinguished. However, three distinct hydrogeologic units can be identified: 1) a Shallow Hydrogeologic Unit (SHU); 2) a Middle Hydrogeologic Unit (MHU); and 3) a Deep Hydrogeologic Unit (DHU). The 30 feet thick Shallow Hydrogeologic Unit includes the Cahokia Alluvium (recent deposits) and the uppermost portion of the Henry Formation. This unit is primarily an unconsolidated, fine grained silty sand with low to moderate permeability. The 40 feet thick Middle Hydrogeologic Unit is formed by the upper to middle, medium to coarse sand portions of the Henry Formation. It contains a higher permeability sand than found in the overlying Shallow Hydrogeologic Unit, and these sands become coarser with depth. At the bottom of the aquifer is the Deep Hydrogeologic Unit which includes the high permeability, coarse-grained deposits of the lower Henry Formation. This zone is estimated to be about 30 to 40 feet thick. In some areas, till and/or boulder zones were encountered 10 to 15 feet above the bedrock.

Recharge of groundwater in the area is received from direct infiltration of precipitation and runoff, subsurface flow of infiltrated precipitation from the bluff area to the east, infiltration from the Mississippi River, and inflow from buried river channels. Direct recharge of the water table captures a portion of the annual precipitation, although a major portion of the precipitation runs off to streams, or is lost by evapotranspiration before it reaches the aquifer. Nevertheless, precipitation is probably the most important recharge source for the site area as a whole. The amount of surface recharge that reaches the saturation zone depends on many factors, including the character of the soil and other materials above the water table, the topography, vegetative cover, land use, soil moisture, depth to the water table, the intensity and seasonal distribution of precipitation, and temperature. Because of the low relief and limited runoff in the study area, and because the upper silt and clay fill allows appreciable recharge, most of the precipitation either evaporates or infiltrates into the soil. Because of the extensive flood-control network in

the area, recharge from floodwaters provides only limited groundwater recharge to the area. The average rate of surface recharge was estimated to be about 371,000 gallons per day/square mile (gpd/mi²) for the site area.

Presently, groundwater levels in the site area range from approximately 10 feet to 20 feet below ground surface, with the depth to groundwater increasing in an east to west direction toward the Mississippi River. However, groundwater levels fluctuate in response to precipitation and have historically varied as much as 50 feet in the past due to previous withdrawals from industrial and municipal pumping centers. There are no pumping centers currently operating in the area of the site.

4.3 Site Geology and Hydrogeology

A site investigation was conducted in two phases. The first occurred during the second week of November 1999, while the second occurred during the third week of November 2000. A total of 7 borings and two hand auger holes were completed on the site. Boring locations are shown on Drawing No. 1 and boring logs are presented in Appendix A. One of the borings was completed as a piezometer, PZ-1, while the remaining holes were backfilled with a cement/bentonite grout.

The surficial soil at the site consists of light to dark brown, firm, low to medium plastic silty clay, ranging in thickness from 0 to 4 feet. The silty clay changes to a very loose to loose silt and sandy silt within the depth range of 4 to 20 feet. This unit is underlain by sand and silty sand to a depth of about 100 feet. This deep sand changes consistency from loose to medium dense at a depth of 20 to 50 feet, to dense to very dense below this depth. The denser sands belong to the middle and lower portions of the Henry Formation. The upper soil units are part of the Cahokia Alluvium and the upper Henry Formations. A subsurface profile is included as Drawing No. 2.

The two units described above correspond to the SHU and the MHU identified in previous studies. The DHU was not penetrated with any of the site borings.

During the site investigation, groundwater was encountered in all borings at the time of drilling. The depth of groundwater during drilling varied between 7 and 15 feet below ground surface, which corresponds to elevations in the range of 386.5 ft MSL to 397.2 ft MSL.

Groundwater elevations in all of the three identified hydrologic units were between 395.5 and 393.5 ft MSL, based on measurements made during the RI/FS in the first and second quarter of 2000. However, it is likely that groundwater elevations change seasonally with the stage of the Mississippi River. These groundwater elevations indicated that the groundwater flow direction at the time of the measurements was to the west-northwest under a horizontal gradient of 0.001 ft./ft. A slightly upward vertical groundwater flow gradient was observed. Piezometric maps are included as Appendix B.

During the RI/FS, 15 slug tests were conducted in general site area. The estimated average hydraulic conductivity for the SHU was 8.9×10^{-3} cm/sec, 3.2×10^{-2} cm/sec for the MHU, and 4.4×10^{-2} cm/sec for the DHU. Aquifer tests performed in the area over a span of 30 years have established characteristics such as transmissivity, hydraulic conductivity, storage coefficient and groundwater velocity. Tests have been conducted for the three groundwater units and are summarized as follows.

	Transmissivity (gpd/ft)	Hydraulic Conductivity (cm/sec)	Storage Coefficient	Groundwater Velocity (ft/day)
SHU	141.5	4×10^{-4}	Not Available	0.02
MHU	165,000	1.6×10^{-1}	0.04	4.4
DHU	211,000	1.2×10^{-1}	.002 to 0.1	6.4

703.185(t

It is believed that the tabulated results from the aquifer tests are the more accurate values since aquifer tests evaluate a much larger representative element of the aquifer than slug tests.

4.4 Aquifer Classification

620.210

Based on the hydraulic properties measured in the aquifers beneath the site, the American Bottoms aquifer satisfies the definition of a Class I: Potable Groundwater Resource given in 35 IAC 620.210. The topmost unit of this aquifer, the Shallow Hydrogeologic Unit, is considered to be the uppermost aquifer at the site.

5 EXISTING GROUNDWATER QUALITY - 703.185(a), 703.185(d), 721 App. I

5.1 Interim Status Monitoring

703.185(a)

The proposed facility is a new installation and no Interim Status data are available.

5.2 Results of Previous Investigations

703.185(a)

703.185(c)

Although no Interim Status monitoring data are available, groundwater quality information is available from the EE/CA and RI/FS recently completed in the general site area. The investigations were performed in the vicinity of four potential source areas, Sites G, H, I, and L, all of which are fill areas shown on Figure 1-1. The locations of the monitoring wells sampled during these investigations are shown on Drawing No. 3. The detailed results are presented in the report submitted to USEPA and a summary of those results that are relevant to the containment facility site is presented in this section. Additional details can be obtained from the EE/CA report.

In summary, the investigation found that groundwater in the vicinity of the containment facility is degraded and contains both volatile and semi-volatile organic compounds (VOCs and SVOCs), as well as some metals. Sampling was conducted in a transect southwest of Site G (refer to Drawing No. 3 for the transect location) to determine whether constituents were present in a cross-gradient direction from the fill areas. Review of the ground-water data reveals that VOC and SVOC data are representative of plume behavior, especially concerning nature and extent of chemical constituents that are present above regulatory levels. Consequently, discussion in the following paragraphs is limited to maximum detected concentrations of SVOCs and VOCs and their relation to constituent migration.

5.3 Volatile Organic Compounds

VOCs occur in the shallow hydrogeologic unit within Sites G, H and L, and within the underlying groundwater. The following table compares maximum detected total VOC

concentrations in Sites G, H and L with concentrations in the transect southwest of Sites G, H and L (refer to Drawing No. 3 for the transect location).

MAXIMUM DETECTED TOTAL VOC CONCENTRATION				
	Fill Area (µg/L)	Southwest Transect (µg/L)		
		AA-SW-S1 25 ft from Site G	AA-SW-S2 275 ft from Site G	AA-SW-S3 600 ft from Site G
Shallow Hydrogeologic Unit	19,153	28	ND	0.3
Middle Hydrogeologic Unit	145	16	12	38
Deep Hydrogeologic Unit	890	7.5	6.5	4.5

Maximum detected total VOC concentrations in the southwest, cross-gradient transect were generally three to five orders of magnitude less than the fill area concentrations in the shallow hydrogeologic unit.

5.4 Semi Volatile Organic Compounds

SVOCs were detected within and below Sites G, H and L. SVOCs were detected sporadically in the sampling transect southwest of Site G. The following table compares maximum detected total SVOC concentrations in Sites G, H, and L with concentrations in the transect southwest of Site G.

MAXIMUM DETECTED TOTAL SVOC CONCENTRATION				
	Fill Area (µg/L)	Southwest Transect (µg/L)		
		AA-SW-S1 25 ft from Site G	AA-SW-S2 275 ft from Site G	AA-SW-S3 600 ft from Site G
Shallow Hydrogeologic Unit	49,290	0.4	ND	0.3
Middle Hydrogeologic Unit	14,957	11	16	7.1
Deep Hydrogeologic Unit	3,013	5.5	1.8	0.9

Maximum detected total SVOC concentration in the southwest, cross-gradient transect were generally four to five orders of magnitude less than the fill area concentrations.

The maximum detected concentrations of VOC and SVOC constituents provide direct evidence that significant contaminant migration has not occurred southwest of Site G, in

the direction of the containment facility. However, maximum detected concentrations of some constituents in cross-gradient sampling locations exceed the standards for Illinois Class I: Potable Resource Groundwater as defined in 35 IAC 620.210 and 35 IAC 620.410, as shown on Table 1. Thus, the groundwater quality at the facility has been impacted, potentially from these sites as well as from other sources present in the area. Mobil, Sterling Steel, and T. J. Moss are located upgradient of the area. Cerro Copper and Sauget Area 2 are located downgradient of the area. All of these industries and Sauget Area 2 serve as potential sources of impact in the area. Further, ground water beneath the general site area is part of a regional ground-water issue, due to multiple historic industrial discharges and historic industrial usage. The potential impacts from these sources will need to be carefully considered when defining the constituents to be included in a long term monitoring plan for the containment facility.

August 3, 2001

6 GROUNDWATER MONITORING SYSTEM – 703.185(e), 703.185(f), 724.197, 724.198

6.1 Groundwater Monitoring System

703.185(f)(2)
724.197(a)

The groundwater monitoring network will consist of 10 monitoring wells in three upgradient locations and three downgradient locations. The upgradient installations will consist of two locations immediately east of the containment cell and west of Dead Creek and one location east of Dead Creek and west of Falling Springs Road, approximately 1000 feet from the edge of the containment cell. Similarly, the two downgradient installations consist of two locations at the toe of the western cell containment berm and one additional location approximately 600 feet downgradient of the toe, at the property boundary. The locations of all of the proposed wells are shown on Drawing No. 4, while the wells closest to the containment facility are shown on Drawing No. 5.

As noted in the previous section, a small vertically upward groundwater gradient exists in the site area. Consequently, some of the monitoring locations will include pairs of wells, one screened in the SHU at a depth of about 25 feet below ground surface and the other screened in the MHU, approximately 50 feet below ground surface. Specifically, well pairs will be installed at upgradient locations TCMW-1 and TCMW-3 shown on Figure 4, while pairs will be installed at downgradient locations TCMW-5 and TCMW-6. Monitoring of the SGU unit will allow the timely identification of any potential releases from the containment unit, while monitoring of the MHU will provide a more general picture of the overall groundwater quality.

6.2 Proposed Point of Compliance

703.183(s)
724.195

The compliance boundary for purposes of determining whether the containment facility is impacting groundwater is defined by the two shallow downgradient well closest to the containment facility, TCMW-4 and TCMW-5S. Since the predominant groundwater gradient in the vicinity of the facility is horizontal, these wells will provide the earliest indication of any such impacts.

August 3, 2001

6.3 Well Construction

703.185(f)(2)
724.197(c)

Monitoring wells will be constructed from 2-inch diameter stainless steel. The top of the well riser will be above the 100-year flood plain elevation of the Mississippi River (408 feet MSL). Well construction details are shown in Drawing No. 6.

Once the monitoring well network is completed, a plot plan indicating exact well locations, well numbering and top of casing elevations will be submitted to USEPA. In addition, copies of the boring and well installation logs, as well as the first round of water level measurements will be furnished.

6.4 Well Replacement

If any one of the monitoring wells is destroyed, or otherwise fails to properly function, the Site will notify the USEPA with 10 days of discovery. If the well cannot be repaired, it will be properly abandoned and replaced within 60 days of the notification. The new well will be sampled within one week of installation to verify its usability.

6.5 Sampling and Analysis Procedures

703.185(f)(4)
724.197(d)
724.197(e)

As noted in Section 2, specific procedures for groundwater sample collection, water level measurement, sample preservation and handling, chain of custody procedures, and analysis of samples collected at the site will be the same as those used during the performance of an Engineering Evaluation/Cost Analysis (EE/CA) and a Remedial Investigation/Feasibility Study (RI/FS) which were both recently completed by Solutia in the general site area. The Field Sampling and the Quality Assurance Project Plans were reviewed by IEPA and were approved by USEPA on September 9, 1999. Thus, those plans satisfy the requirements of 35 IAC 703.185(f)(4), 724.197(d), and 724.197(e) and are incorporated into this GMP by reference. All sampling and analysis of groundwater from the site will be performed in strict accordance with the procedures and methods outlined in these plans.

August 3, 2001

703.185(f)(3)
724.197(g)
724.197(c)

6.6 Background Groundwater Quality

Selection of appropriate background groundwater quality concentrations at this site is complicated by the fact that the existing groundwater quality has been degraded. Consequently, the background concentrations which are used in routine statistical comparisons to determine if statistically significant changes have occurred in downgradient wells must take this possibility into account.

During the first year of operation of the groundwater monitoring network, the background groundwater quality will be initially established. A minimum of four (4) samples taken from the upgradient monitoring wells, one every three months for a one-year period, will be used to determine the initial background water quality. After the first year's data, new quarterly sampling results will be incorporated into the background groundwater quality standard that will be used to evaluate whether leachate from the containment facility has impacted groundwater.

As noted above, groundwater quality in the general site area has been impacted and it is possible that contaminated groundwater from a number of potential upgradient sources may migrate on to the site. The result of such migration could be a change in the background groundwater quality over time. In turn, this change could lead to the mistaken conclusion that the containment cell is leaking. Consequently, the background groundwater quality standard will be recomputed prior to each monitoring event using the 13 most recent rounds of groundwater data. Use of a moving average of the 13 most recent rounds of groundwater data will result in a 99 percent confidence prediction limit that the concentration of one constituent from a sample of one well will not be a false positive (the value of 13 is a non-parametric property of any statistical distribution of data). Thus, it will permit differentiation between groundwater impacts resulting from changes in the upgradient groundwater quality and from potential leakage from the containment facility with a high degree of confidence.

6.7 Sampling Frequency

724.198(d)

The sampling frequency will be quarterly until 13 consecutive samples have been collected. During this period, enough groundwater data will have been collected to adequately describe the site groundwater quality. However, once this has been accomplished, the sampling frequency will be reduced to semi annually. This is appropriate because of the low groundwater flow velocity in the SHU, approximately 7.3 feet per year. With this low velocity, the travel distance of any possible constituent will be limited to less than 4 feet between sampling events and will most probably be considerably less because of retardation effects in the aquifer.

6.8 Indicator Parameters

703.185(f)
724.198(a)

As noted in an earlier section of this plan, the groundwater is currently degraded and contains a number of organic and inorganic constituents. This fact complicates the selection of an appropriate suite of monitoring parameters which will reliably detect a release from the containment facility. A detection monitoring list will consist of a suite of parameters that can be monitored in groundwater samples collected at the perimeter of the facility. The parameters chosen for inclusion on this list should include constituents that are present in the contents of the containment facility (i.e. Dead Creek sediment), that can potentially leach from the waste in sufficient concentrations to be detectable in groundwater, that will migrate readily in groundwater, and that have low existing concentrations in the background groundwater. Ideally, a set of indicator parameters which are unique to the contents of the containment facility should be selected. To this end, the existing sediment and groundwater analytical data in the vicinity of the facility were evaluated to identify a suite of detection monitoring parameters that best satisfy these criteria.

In 1998 Ecology and Environment (E&E) compiled historical analytical results from sediment analytical data for Dead Creek. A summary of their compilation is presented in the Draft Time Critical Removal Action Work Plan submitted to USEPA on June 30,

2000. Table 2 shows the constituents that were detected in sediment during these investigations, together with their maximum concentrations. The Draft Time Critical Removal Action Work Plan also presented and discussed the results of an additional 13 sediment samples that were collected as part of the Support Sampling Plan (SSP) completed in April 2000. These sediment samples were analyzed for volatile organic compound (VOC), semi-volatile organic compound (SVOC), pesticide, herbicide, polychlorinated biphenyl (PCBs), various inorganic parameters and dioxins. Table 3 shows the constituents that were detected in this recent investigation and their respective concentrations.

These results demonstrate that VOCs, SVOCs, PCBs, some pesticides and herbicides, and some metals were all detected in the sediment. No unique characteristics are immediately apparent on examination of these tables. Accordingly, all samples will be analyzed for the following compounds, using the USEPA methods indicated:

- Volatile Organic Compounds by SW-846 Method 8260
- Semi-Volatile Organic Compounds by SW-846 Method 8270
- PCBs by Method 680
- Metals, by SW-846 Method 6010, to include:
 - Antimony
 - Arsenic
 - Chromium
 - Copper
 - Iron
 - Lead
 - Manganese
 - Nickel
 - Zinc

August 3, 2001

These constituents will be subjected to detailed analyses to determine if the downgradient groundwater quality has undergone a statistically significant change, using the procedures described in the following section and on Drawing No.7.

6.9 Statistical Analyses

703.185(f)(4)
724.197(h)
724.198(d)
724.198(f)
724.198(g)

Inter-well statistical analyses will be performed in accordance with the methods recommended in ASTM D6312-98, a copy of which is attached as Appendix C. These methods are consistent with the requirements of 35 IAC 724.197(h).

As noted above, the background groundwater quality standard will be recomputed prior to each monitoring event using the 13 most recent rounds of groundwater data. Initially, all of the six background and downgradient wells in the SHU will be used for purposes of determining if a statistically significant change in the concentrations of any of the parameters has occurred in the shallow groundwater. A separate comparison will also be carried out using the four background and downgradient wells in the MHU. As shown on Drawing No. 7, if such a change is detected, the evaluation will then center on the four shallow wells closest to the containment facility and background groundwater quality will be computed from the two shallow background wells immediately upgradient of the cell (TCMW-2 and TCMW-3S on Figure 5).

If any statistically significant changes are detected, a final check will be made to confirm that the increase is a result of leakage from the cell. That check will consist of sampling any free liquids in the secondary leachate collection sump of the cell, on the basis that any leakage from the cell to groundwater must pass through the lining system and, hence, must be detectable in the leak detection sump. If this sampling confirms that the increase in groundwater concentration is likely due to cell leakage, verification re-sampling will be done in accordance with guidelines set forth in ASTM D 6312-98.

On the basis of the statistical analyses, if no significant change is detected in a specific parameter after the collection of 13 rounds of monitoring data (i.e., after sufficient data

have been collected to allow a 99 percent confidence prediction limit), approval will be sought to remove that parameter from the list of indicator parameters.

6.10 Reports

724.197(j)

Semi-annual reports will be submitted which will summarize the groundwater monitoring data, the results of the statistical analyses, and recommendations for changes in the monitoring program, if appropriate. The report will also contain potentiometric maps showing the shallow groundwater surface at the site, the horizontal and vertical groundwater gradients, and the horizontal groundwater velocity.

Tables

Table 1
Groundwater Quality Regulatory Exceedances
Sauget Area 1

Sample ID	Sample Date	STORET	Parameter	Units	Result	Flag	MCL	Class 1 ILGWQS
EEG-107	10/7/99	34551	1,2,4-Trichlorobenzene	ug/L	180	J	70	70
EEG-107	10/7/99	34571	1,4-Dichlorobenzene	ug/L	850		75	75
EE-05	10/13/99	39760	2,4,5-TP (Silvex)	ug/L	390		50	50
EEG-107	10/7/99	39730	2,4-D	ug/L	120		70	70
AA-GHL-S1-107-111FT	12/2/99	1097	Antimony	ug/L	7.9	B	6	6
EEG-107	10/7/99	1097	Antimony	ug/L	8.6	B	6	6
EEG-109	10/11/99	1002	Arsenic	ug/L	4,300		50	50
EE-05	10/13/99	34030	Benzene	ug/L	110		5	5
EEG-107	10/7/99	34030	Benzene	ug/L	3,700	D	5	5
EEG-109	10/11/99	34030	Benzene	ug/L	44		5	5
AA-GHL-S1-107-111FT	12/2/99	34247	Benzo(a)pyrene	ug/L	5.7	J	0.2	0.2
AA-GHL-S1-62-66FT	11/29/99	34301	Chlorobenzene	ug/L	270	D	100	100
EE-05	10/13/99	34301	Chlorobenzene	ug/L	620		100	100
EEG-107	10/7/99	34301	Chlorobenzene	ug/L	4,300	D	100	100
AA-GHL-S1-102-106FT	12/1/99	1034	Chromium	ug/L	110		100	100
AA-GHL-S1-82-86FT	11/30/99	1034	Chromium	ug/L	160		100	100
AA-SW-S1-101-104FT	11/8/99	1034	Chromium	ug/L	180	N	100	100
AA-SW-S1-82-86FT	11/5/99	1034	Chromium	ug/L	300	N	100	100
AA-SW-S2-72-76FT	11/11/99	1034	Chromium	ug/L	250		100	100
AA-SW-S2-82-86FT	11/11/99	1034	Chromium	ug/L	410		100	100
AA-SW-S2-92-96FT	11/12/99	1034	Chromium	ug/L	270		100	100
AA-GHL-S1-102-106FT	12/1/99	1045	Iron	ug/L	54,000		NA	5,000
AA-GHL-S1-107-111FT	12/2/99	1045	Iron	ug/L	45,000		NA	5,000
AA-GHL-S1-42-46FT	11/18/99	1045	Iron	ug/L	11,000	N	NA	5,000
AA-GHL-S1-52-56FT	11/19/99	1045	Iron	ug/L	27,000		NA	5,000
AA-GHL-S1-62-66FT	11/29/99	1045	Iron	ug/L	23,000		NA	5,000
AA-GHL-S1-72-76FT	11/30/99	1045	Iron	ug/L	14,000		NA	5,000
AA-GHL-S1-82-86FT	11/30/99	1045	Iron	ug/L	67,000		NA	5,000
AA-GHL-S1-92-96FT	12/1/99	1045	Iron	ug/L	21,000		NA	5,000
AA-SW-S1-101-104FT	11/8/99	1045	Iron	ug/L	47,000	*	NA	5,000
AA-SW-S1-24-26FT	11/2/99	1045	Iron	ug/L	9,100		NA	5,000
AA-SW-S1-34-36FT	11/2/99	1045	Iron	ug/L	11,000		NA	5,000
AA-SW-S1-42-46FT	11/3/99	1045	Iron	ug/L	25,000		NA	5,000
AA-SW-S1-52-56FT	11/3/99	1045	Iron	ug/L	20,000		NA	5,000
AA-SW-S1-62-66FT	11/4/99	1045	Iron	ug/L	20,000	*	NA	5,000
AA-SW-S1-72-76FT	11/4/99	1045	Iron	ug/L	17,000	*	NA	5,000
AA-SW-S1-82-86FT	11/5/99	1045	Iron	ug/L	87,000	*	NA	5,000
AA-SW-S1-91-95FT	11/5/99	1045	Iron	ug/L	39,000	*	NA	5,000
AA-SW-S2-102-106FT	11/15/99	1045	Iron	ug/L	30,000	N	NA	5,000
AA-SW-S2-22-26FT	11/9/99	1045	Iron	ug/L	6,700		NA	5,000
AA-SW-S2-32-36FT	11/9/99	1045	Iron	ug/L	9,300		NA	5,000
AA-SW-S2-42-46FT	11/10/99	1045	Iron	ug/L	24,000		NA	5,000
AA-SW-S2-52-56FT	11/11/99	1045	Iron	ug/L	31,000		NA	5,000
AA-SW-S2-62-66FT	11/10/99	1045	Iron	ug/L	28,000		NA	5,000
AA-SW-S2-72-76FT	11/11/99	1045	Iron	ug/L	73,000		NA	5,000
AA-SW-S2-82-86FT	11/11/99	1045	Iron	ug/L	110,000		NA	5,000
AA-SW-S2-92-96FT	11/12/99	1045	Iron	ug/L	82,000		NA	5,000
EE-05	10/13/99	1045	Iron	ug/L	46,000	N	NA	5,000

Table 1
Groundwater Quality Regulatory Exceedances
Sauget Area 1

Sample ID	Sample Date	STORET	Parameter	Units	Result	Flag	MCL	Class 1 ILGWQS
EEG-101	10/8/99	1045	Iron	ug/L	6,400		NA	5,000
EEG-102	10/7/99	1045	Iron	ug/L	6,500		NA	5,000
EEG-107	10/7/99	1045	Iron	ug/L	270,000		NA	5,000
EEG-109	10/11/99	1045	Iron	ug/L	290,000	N	NA	5,000
UGGW-EEG-108	10/11/99	1045	Iron	ug/L	32,000	N	NA	5,000
UGGW-EEG-108-100FT	1/31/00	1045	Iron	ug/L	20,000	N	NA	5,000
UGGW-EEG-108-60FT	1/28/00	1045	Iron	ug/L	20,000		NA	5,000
AA-GHL-S1-102-106FT	12/1/99	1051	Lead	ug/L	17		15	7.5
AA-GHL-S1-107-111FT	12/2/99	1051	Lead	ug/L	11		15	7.5
AA-GHL-S1-82-86FT	11/30/99	1051	Lead	ug/L	22		15	7.5
AA-SW-S1-101-104FT	11/8/99	1051	Lead	ug/L	13		15	7.5
AA-SW-S1-24-26FT	11/2/99	1051	Lead	ug/L	7.7		15	7.5
AA-SW-S1-82-86FT	11/5/99	1051	Lead	ug/L	35		15	7.5
AA-SW-S1-91-95FT	11/5/99	1051	Lead	ug/L	10		15	7.5
AA-SW-S2-102-106FT	11/15/99	1051	Lead	ug/L	8.7		15	7.5
AA-SW-S2-72-76FT	11/11/99	1051	Lead	ug/L	29		15	7.5
AA-SW-S2-82-86FT	11/11/99	1051	Lead	ug/L	42		15	7.5
AA-SW-S2-92-96FT	11/12/99	1051	Lead	ug/L	24		15	7.5
EEG-107	10/7/99	1051	Lead	ug/L	24		15	7.5
AA-GHL-S1-102-106FT	12/1/99	1055	Manganese	ug/L	2,900		NA	150
AA-GHL-S1-107-111FT	12/2/99	1055	Manganese	ug/L	1,900		NA	150
AA-GHL-S1-22-26FT	11/17/99	1055	Manganese	ug/L	750		NA	150
AA-GHL-S1-32-36FT	11/18/99	1055	Manganese	ug/L	1,700		NA	150
AA-GHL-S1-42-46FT	11/18/99	1055	Manganese	ug/L	2,000		NA	150
AA-GHL-S1-52-56FT	11/19/99	1055	Manganese	ug/L	1,900		NA	150
AA-GHL-S1-62-66FT	11/29/99	1055	Manganese	ug/L	1,400		NA	150
AA-GHL-S1-72-76FT	11/30/99	1055	Manganese	ug/L	760		NA	150
AA-GHL-S1-82-86FT	11/30/99	1055	Manganese	ug/L	2,200		NA	150
AA-GHL-S1-92-96FT	12/1/99	1055	Manganese	ug/L	680		NA	150
AA-SW-S1-101-104FT	11/8/99	1055	Manganese	ug/L	1,000	N	NA	150
AA-SW-S1-14-16FT	11/1/99	1055	Manganese	ug/L	780		NA	150
AA-SW-S1-24-26FT	11/2/99	1055	Manganese	ug/L	620		NA	150
AA-SW-S1-34-36FT	11/2/99	1055	Manganese	ug/L	1,500		NA	150
AA-SW-S1-42-46FT	11/3/99	1055	Manganese	ug/L	1,200		NA	150
AA-SW-S1-52-56FT	11/3/99	1055	Manganese	ug/L	1,100		NA	150
AA-SW-S1-62-66FT	11/4/99	1055	Manganese	ug/L	1,100	N	NA	150
AA-SW-S1-72-76FT	11/4/99	1055	Manganese	ug/L	740	N	NA	150
AA-SW-S1-82-86FT	11/5/99	1055	Manganese	ug/L	1,900	N	NA	150
AA-SW-S1-91-95FT	11/5/99	1055	Manganese	ug/L	1,000	N	NA	150
AA-SW-S2-102-106FT	11/15/99	1055	Manganese	ug/L	760		NA	150
AA-SW-S2-22-26FT	11/9/99	1055	Manganese	ug/L	1,300		NA	150
AA-SW-S2-32-36FT	11/9/99	1055	Manganese	ug/L	1,400		NA	150
AA-SW-S2-42-46FT	11/10/99	1055	Manganese	ug/L	970		NA	150
AA-SW-S2-52-56FT	11/11/99	1055	Manganese	ug/L	1,000		NA	150
AA-SW-S2-62-66FT	11/10/99	1055	Manganese	ug/L	800		NA	150
AA-SW-S2-72-76FT	11/11/99	1055	Manganese	ug/L	2,400		NA	150
AA-SW-S2-82-86FT	11/11/99	1055	Manganese	ug/L	3,700		NA	150
AA-SW-S2-92-96FT	11/12/99	1055	Manganese	ug/L	2,800		NA	150

Table 1
Groundwater Quality Regulatory Exceedances
Sauget Area 1

Sample ID	Sample Date	STORET	Parameter	Units	Result	Flag	MCL	Class 1 ILGWQS
EE-05	10/13/99	1055	Manganese	ug/L	1,100	N	NA	150
EEG-101	10/8/99	1055	Manganese	ug/L	2,400	N	NA	150
EEG-102	10/7/99	1055	Manganese	ug/L	830	N	NA	150
EEG-103-GP	11/3/99	1055	Manganese	ug/L	270		NA	150
EEG-104	10/8/99	1055	Manganese	ug/L	720	N	NA	150
EEG-107	10/7/99	1055	Manganese	ug/L	6,100	N	NA	150
EEG-109	10/11/99	1055	Manganese	ug/L	10,000	N	NA	150
EEG-110	10/11/99	1055	Manganese	ug/L	1,600	N	NA	150
UGGW-EEG-108	10/11/99	1055	Manganese	ug/L	1,300	N	NA	150
UGGW-EEG-108-100FT	1/31/00	1055	Manganese	ug/L	580		NA	150
UGGW-EEG-108-60FT	1/28/00	1055	Manganese	ug/L	620		NA	150
AA-SW-S1-82-86FT	11/5/99	1067	Nickel	ug/L	110		NA	100
AA-SW-S2-82-86FT	11/11/99	1067	Nickel	ug/L	160		NA	100
AA-SW-S2-92-96FT	11/12/99	1067	Nickel	ug/L	110		NA	100
EEG-107	10/7/99	1067	Nickel	ug/L	120		NA	100
EEG-109	10/11/99	1067	Nickel	ug/L	180,000		NA	100
EEG-110	10/11/99	1067	Nickel	ug/L	150		NA	100
AA-SW-S1-91-95FT	11/5/99	39032	Pentachlorophenol	ug/L	1.4		1	1
EEG-107	10/7/99	39032	Pentachlorophenol	ug/L	19	J	1	1
EEG-107	10/7/99	39032	Pentachlorophenol	ug/L	2,000		1	1
AA-GHL-S1-12-16FT	11/16/99	34475	Tetrachloroethene	ug/L	13		5	5
AA-GHL-S1-22-26FT	11/17/99	34475	Tetrachloroethene	ug/L	7.1		5	5
EEG-107	10/7/99	34475	Tetrachloroethene	ug/L	170		5	5
EEG-109	10/11/99	1059	Thallium	ug/L	6.1	B	2	2
EEG-107	10/7/99	34010	Toluene	ug/L	8,500	D	1,000	1,000
EE-05	10/13/99	39180	Trichloroethene	ug/L	18	J	5	5
EEG-107	10/7/99	39180	Trichloroethene	ug/L	200		5	5
EEG-107	10/7/99	39175	Vinyl chloride	ug/L	41	J	2	2

NA - Not Applicable

Table 2
Constituents Detected in Sediment
Maximum Historical Results Compiled by Ecology and Environment
Dead Creek - Sauget Area 1

Parameter	E&E Maximum Detection (mg/kg)
VOCs	
2-Butanone	14
4-Methyl-2-Pentanone	1.2
Acetone	5
Benzene	<1
Carbon Disulfide	<1
Chlorobenzene	13
Ethylbenzene	4
Methylene Chloride	<1
Tetrachloroethane	<1
Toluene	5
Xylene (assumed total)	<1
Inorganics	
Antimony	45
Arsenic	306
Barium	17,300
Beryllium	3
Boron	76
Cadmium	400
Chromium (assumed total)	400
Cobalt	100
Copper	44,800
Cyanide	4
Lead	24,000
Mercury	30
Nickel	3,500
Selenium	602
Silver	100
Strontium	430
Thallium	4
Tin	32
Vanadium	100
Zinc	71,000
SVOCs	
1,2,4-Trichlorobenzene	3,700
1,2,4-Trichlorophenol	5
1,2-Dichlorobenzene	12,000
1,3-Dichlorobenzene	4
1,4-Dichlorobenzene	220
2,4,5-Trichlorophenol	<1
2,4,6-Trichlorophenol	<1
2,4-Dichlorophenol	<1
2,4-Dimethylphenol	<1
2-Chlorophenol	<1
2-Methylnapthalene	8
4-Methylphenol	<1
4-Nitrophenol	3

Table 2
Constituents Detected in Sediment
Maximum Historical Results Compiled by Ecology and Environment
Dead Creek - Sauget Area 1

Parameter	E&E Maximum Detection (mg/kg)
Acenaphthylene	<1
Acenaphthene	3
Alkylbenzene	<1
Anthracene	4
Benzo(a)anthracene	9
Benzo(a)pyrene	10
Benzo(b)fluoranthene	30
Benzo(g,h,i)perylene	13
Benzo(k)fluoranthene	15
Bis(2-ethylhexyl)phthalate	18
Butylbenzylphthalate	2
Chloronitrobenzene	240
Chrysene	12
Dibenzo(a,h)anthracene	4
Dibenzofuran	2
Di-n-butyl phthalate	<1
Di-ni-octyl phthalate	3
Fluoranthene	21
Fluorene	6
Hexachlorobenzene	2
Indeno(1,2,3-cd)pyrene	9
Isophorone	<1
Napthalene	10
Pentachlorophenol	2
Phenanthrene	15
Phenol	<1
Pyrene	27
PCBs	
PCBs	17,000

Notes:

Source: Draft Time Critical Removal Action Plan,
O'Brien & Gere Engineers, Inc., June 30, 2000
E&E - Ecology and Environment

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
VOCs						
10/5/99	SED-CSB-S1-0.2FT	2-Butanone (MEK)	ug/kg dw	130	J	62.5
10/5/99	SED-CSB-S2-0.2FT	2-Butanone (MEK)	ug/kg dw	98	J	62.5
10/5/99	SED-CSB-S3-0.2FT	2-Butanone (MEK)	ug/kg dw	190	J	83.3
10/4/99	SED-CSC-S1-0.2FT	2-Butanone (MEK)	ug/kg dw	31	J	86
10/4/99	SED-CSC-S2-0.2FT	2-Butanone (MEK)	ug/kg dw	37	J	71
10/4/99	SED-CSC-S3-0.2FT	2-Butanone (MEK)	ug/kg dw	28	J	96
10/4/99	SED-CSD-S1-0.2FT	2-Butanone (MEK)	ug/kg dw	65	J	108.7
10/4/99	SED-CSD-S2-0.2FT	2-Butanone (MEK)	ug/kg dw	56	J	119
10/4/99	SED-CSD-S3-0.2FT	2-Butanone (MEK)	ug/kg dw	30	J	74
10/6/99	SED-CSE-S1-0.2FT	2-Butanone (MEK)	ug/kg dw	150	J	89
10/6/99	SED-CSE-S2-0.2FT	2-Butanone (MEK)	ug/kg dw	94	J	66
10/6/99	SED-CSE-S3-0.2FT	2-Butanone (MEK)	ug/kg dw	520	B	83.3
10/5/99	SED-M-S1-0.2FT	2-Butanone (MEK)	ug/kg dw	270	B	125
10/5/99	SED-CSB-S1-0.2FT	2-Hexanone	ug/kg dw	130	U	130
10/5/99	SED-CSB-S2-0.2FT	2-Hexanone	ug/kg dw	21	J	62.5
10/5/99	SED-CSB-S3-0.2FT	2-Hexanone	ug/kg dw	190	U	190
10/4/99	SED-CSC-S1-0.2FT	2-Hexanone	ug/kg dw	130	U	130
10/4/99	SED-CSC-S2-0.2FT	2-Hexanone	ug/kg dw	110	U	110
10/4/99	SED-CSC-S3-0.2FT	2-Hexanone	ug/kg dw	140	U	140
10/4/99	SED-CSD-S1-0.2FT	2-Hexanone	ug/kg dw	200	U	200
10/4/99	SED-CSD-S2-0.2FT	2-Hexanone	ug/kg dw	200	U	200
10/4/99	SED-CSD-S3-0.2FT	2-Hexanone	ug/kg dw	100	U	100
10/6/99	SED-CSE-S1-0.2FT	2-Hexanone	ug/kg dw	150	U	150
10/6/99	SED-CSE-S2-0.2FT	2-Hexanone	ug/kg dw	94	U	94
10/6/99	SED-CSE-S3-0.2FT	2-Hexanone	ug/kg dw	130	U	130
10/5/99	SED-M-S1-0.2FT	2-Hexanone	ug/kg dw	210	U	210
10/5/99	SED-CSB-S1-0.2FT	Acetone	ug/kg dw	260	J	125
10/5/99	SED-CSB-S2-0.2FT	Acetone	ug/kg dw	250	B	125
10/5/99	SED-CSB-S3-0.2FT	Acetone	ug/kg dw	380	J	166.7
10/4/99	SED-CSC-S1-0.2FT	Acetone	ug/kg dw	96	J	172
10/4/99	SED-CSC-S2-0.2FT	Acetone	ug/kg dw	130	J	143
10/4/99	SED-CSC-S3-0.2FT	Acetone	ug/kg dw	100	J	192
10/4/99	SED-CSD-S1-0.2FT	Acetone	ug/kg dw	190	J	217
10/4/99	SED-CSD-S2-0.2FT	Acetone	ug/kg dw	170	J	238
10/4/99	SED-CSD-S3-0.2FT	Acetone	ug/kg dw	84	J	147
10/6/99	SED-CSE-S1-0.2FT	Acetone	ug/kg dw	430		179
10/6/99	SED-CSE-S2-0.2FT	Acetone	ug/kg dw	190	J	132
10/6/99	SED-CSE-S3-0.2FT	Acetone	ug/kg dw	1,200	B	166.7
10/5/99	SED-M-S1-0.2FT	Acetone	ug/kg dw	920	B	250
10/5/99	SED-CSB-S1-0.2FT	Benzene	ug/kg dw	28	U	26
10/5/99	SED-CSB-S2-0.2FT	Benzene	ug/kg dw	20	U	20
10/5/99	SED-CSB-S3-0.2FT	Benzene	ug/kg dw	38	U	38
10/4/99	SED-CSC-S1-0.2FT	Benzene	ug/kg dw	27	U	27
10/4/99	SED-CSC-S2-0.2FT	Benzene	ug/kg dw	22	U	22
10/4/99	SED-CSC-S3-0.2FT	Benzene	ug/kg dw	29	U	29
10/4/99	SED-CSD-S1-0.2FT	Benzene	ug/kg dw	40	U	40
10/4/99	SED-CSD-S2-0.2FT	Benzene	ug/kg dw	41	U	41
10/4/99	SED-CSD-S3-0.2FT	Benzene	ug/kg dw	20	U	20
10/6/99	SED-CSE-S1-0.2FT	Benzene	ug/kg dw	30	U	30
10/6/99	SED-CSE-S2-0.2FT	Benzene	ug/kg dw	19	U	19
10/6/99	SED-CSE-S3-0.2FT	Benzene	ug/kg dw	25	U	25
10/5/99	SED-M-S1-0.2FT	Benzene	ug/kg dw	17	J	25
10/5/99	SED-CSB-S1-0.2FT	Carbon disulfide	ug/kg dw	26	U	26
10/5/99	SED-CSB-S2-0.2FT	Carbon disulfide	ug/kg dw	20	U	20
10/5/99	SED-CSB-S3-0.2FT	Carbon disulfide	ug/kg dw	38	U	38
10/4/99	SED-CSC-S1-0.2FT	Carbon disulfide	ug/kg dw	27	U	27
10/4/99	SED-CSC-S2-0.2FT	Carbon disulfide	ug/kg dw	22	U	22
10/4/99	SED-CSC-S3-0.2FT	Carbon disulfide	ug/kg dw	29	U	29
10/4/99	SED-CSD-S1-0.2FT	Carbon disulfide	ug/kg dw	40	U	40

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/4/99	SED-CSD-S2-0.2FT	Carbon disulfide	ug/kg dw	41	U	41
10/4/99	SED-CSD-S3-0.2FT	Carbon disulfide	ug/kg dw	20	U	20
10/6/99	SED-CSE-S1-0.2FT	Carbon disulfide	ug/kg dw	30	U	30
10/6/99	SED-CSE-S2-0.2FT	Carbon disulfide	ug/kg dw	19	U	19
10/6/99	SED-CSE-S3-0.2FT	Carbon disulfide	ug/kg dw	25	U	25
10/5/99	SED-M-S1-0.2FT	Carbon disulfide	ug/kg dw	49		25
10/5/99	SED-CSB-S1-0.2FT	Chlorobenzene	ug/kg dw	86		12.5
10/5/99	SED-CSB-S2-0.2FT	Chlorobenzene	ug/kg dw	26		12.5
10/5/99	SED-CSB-S3-0.2FT	Chlorobenzene	ug/kg dw	20	J	16.7
10/4/99	SED-CSC-S1-0.2FT	Chlorobenzene	ug/kg dw	27	U	27
10/4/99	SED-CSC-S2-0.2FT	Chlorobenzene	ug/kg dw	22	U	22
10/4/99	SED-CSC-S3-0.2FT	Chlorobenzene	ug/kg dw	29	U	29
10/4/99	SED-CSD-S1-0.2FT	Chlorobenzene	ug/kg dw	40	U	40
10/4/99	SED-CSD-S2-0.2FT	Chlorobenzene	ug/kg dw	41	U	41
10/4/99	SED-CSD-S3-0.2FT	Chlorobenzene	ug/kg dw	20	U	20
10/6/99	SED-CSE-S1-0.2FT	Chlorobenzene	ug/kg dw	30	U	30
10/6/99	SED-CSE-S2-0.2FT	Chlorobenzene	ug/kg dw	19	U	19
10/6/99	SED-CSE-S3-0.2FT	Chlorobenzene	ug/kg dw	25	U	25
10/5/99	SED-M-S1-0.2FT	Chlorobenzene	ug/kg dw	100		25
10/5/99	SED-CSB-S1-0.2FT	Toluene	ug/kg dw	26	U	26
10/5/99	SED-CSB-S2-0.2FT	Toluene	ug/kg dw	20		12.5
10/5/99	SED-CSB-S3-0.2FT	Toluene	ug/kg dw	38	U	38
10/4/99	SED-CSC-S1-0.2FT	Toluene	ug/kg dw	27	U	27
10/4/99	SED-CSC-S2-0.2FT	Toluene	ug/kg dw	22	U	22
10/4/99	SED-CSC-S3-0.2FT	Toluene	ug/kg dw	29	U	29
10/4/99	SED-CSD-S1-0.2FT	Toluene	ug/kg dw	40	U	40
10/4/99	SED-CSD-S2-0.2FT	Toluene	ug/kg dw	41	U	41
10/4/99	SED-CSD-S3-0.2FT	Toluene	ug/kg dw	20	U	20
10/6/99	SED-CSE-S1-0.2FT	Toluene	ug/kg dw	30	U	30
10/6/99	SED-CSE-S2-0.2FT	Toluene	ug/kg dw	19	U	19
10/6/99	SED-CSE-S3-0.2FT	Toluene	ug/kg dw	25	U	25
10/5/99	SED-M-S1-0.2FT	Toluene	ug/kg dw	42	U	42
Inorganics						
10/5/99	SED-CSB-S1-0.2FT	Aluminum	mg/kg dw	6,900		50
10/5/99	SED-CSB-S2-0.2FT	Aluminum	mg/kg dw	8,300		50
10/5/99	SED-CSB-S3-0.2FT	Aluminum	mg/kg dw	12,000		66.7
10/4/99	SED-CSC-S1-0.2FT	Aluminum	mg/kg dw	15,000		69
10/4/99	SED-CSC-S2-0.2FT	Aluminum	mg/kg dw	12,000		57
10/4/99	SED-CSC-S3-0.2FT	Aluminum	mg/kg dw	9,700		77
10/4/99	SED-CSD-S1-0.2FT	Aluminum	mg/kg dw	13,000		87
10/4/99	SED-CSD-S2-0.2FT	Aluminum	mg/kg dw	16,000		95
10/4/99	SED-CSD-S3-0.2FT	Aluminum	mg/kg dw	13,000		59
10/6/99	SED-CSE-S1-0.2FT	Aluminum	mg/kg dw	15,000		71
10/6/99	SED-CSE-S2-0.2FT	Aluminum	mg/kg dw	13,000		53
10/6/99	SED-CSE-S3-0.2FT	Aluminum	mg/kg dw	11,000		66.7
10/5/99	SED-M-S1-0.2FT	Aluminum	mg/kg dw	8,900		100
10/5/99	SED-CSB-S1-0.2FT	Antimony	mg/kg dw	9.2	N	5
10/5/99	SED-CSB-S2-0.2FT	Antimony	mg/kg dw	6.3	N	5
10/5/99	SED-CSB-S3-0.2FT	Antimony	mg/kg dw	6.8	N	6.7
10/4/99	SED-CSC-S1-0.2FT	Antimony	mg/kg dw	1.8	B	6.9
10/4/99	SED-CSC-S2-0.2FT	Antimony	mg/kg dw	1.3	B	5.7
10/4/99	SED-CSC-S3-0.2FT	Antimony	mg/kg dw	2.2	B	7.7
10/4/99	SED-CSD-S1-0.2FT	Antimony	mg/kg dw	8.7	U	8.7
10/4/99	SED-CSD-S2-0.2FT	Antimony	mg/kg dw	8.7	U	8.7
10/4/99	SED-CSD-S3-0.2FT	Antimony	mg/kg dw	5.9	U	5.9
10/6/99	SED-CSE-S1-0.2FT	Antimony	mg/kg dw	2.7	B	7
10/6/99	SED-CSE-S2-0.2FT	Antimony	mg/kg dw	2	B	5
10/6/99	SED-CSE-S3-0.2FT	Antimony	mg/kg dw	6.1	U	6.1
10/5/99	SED-M-S1-0.2FT	Antimony	mg/kg dw	6.6	B	10
10/5/99	SED-CSB-S1-0.2FT	Arsenic	mg/kg dw	35		2.5

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/5/99	SED-CSB-S2-0.2FT	Arsenic	mg/kg dw	38		2.5
10/5/99	SED-CSB-S3-0.2FT	Arsenic	mg/kg dw	25		3.3
10/4/99	SED-CSC-S1-0.2FT	Arsenic	mg/kg dw	28		3.4
10/4/99	SED-CSC-S2-0.2FT	Arsenic	mg/kg dw	17		2.9
10/4/99	SED-CSC-S3-0.2FT	Arsenic	mg/kg dw	16		3.8
10/4/99	SED-CSD-S1-0.2FT	Arsenic	mg/kg dw	16		4.3
10/4/99	SED-CSD-S2-0.2FT	Arsenic	mg/kg dw	17		4.8
10/4/99	SED-CSD-S3-0.2FT	Arsenic	mg/kg dw	10		2.9
10/6/99	SED-CSE-S1-0.2FT	Arsenic	mg/kg dw	16		4
10/6/99	SED-CSE-S2-0.2FT	Arsenic	mg/kg dw	12		3
10/6/99	SED-CSE-S3-0.2FT	Arsenic	mg/kg dw	9.3		3.3
10/5/99	SED-M-S1-0.2FT	Arsenic	mg/kg dw	35		5
10/5/99	SED-CSB-S1-0.2FT	Barium	mg/kg dw	950		2.5
10/5/99	SED-CSB-S2-0.2FT	Barium	mg/kg dw	3,300		2.5
10/5/99	SED-CSB-S3-0.2FT	Barium	mg/kg dw	1,700		3.3
10/4/99	SED-CSC-S1-0.2FT	Barium	mg/kg dw	470		3.4
10/4/99	SED-CSC-S2-0.2FT	Barium	mg/kg dw	680		2.9
10/4/99	SED-CSC-S3-0.2FT	Barium	mg/kg dw	800		3.8
10/4/99	SED-CSD-S1-0.2FT	Barium	mg/kg dw	380		4.3
10/4/99	SED-CSD-S2-0.2FT	Barium	mg/kg dw	400		4.8
10/4/99	SED-CSD-S3-0.2FT	Barium	mg/kg dw	310		2.9
10/6/99	SED-CSE-S1-0.2FT	Barium	mg/kg dw	340		4
10/6/99	SED-CSE-S2-0.2FT	Barium	mg/kg dw	290		3
10/6/99	SED-CSE-S3-0.2FT	Barium	mg/kg dw	190		3.3
10/5/99	SED-M-S1-0.2FT	Barium	mg/kg dw	700		5
10/5/99	SED-CSB-S1-0.2FT	Beryllium	mg/kg dw	1	B	1
10/5/99	SED-CSB-S2-0.2FT	Beryllium	mg/kg dw	1		1
10/5/99	SED-CSB-S3-0.2FT	Beryllium	mg/kg dw	1.2	B	1.3
10/4/99	SED-CSC-S1-0.2FT	Beryllium	mg/kg dw	1.2	B	1.4
10/4/99	SED-CSC-S2-0.2FT	Beryllium	mg/kg dw	0.93	B	1.1
10/4/99	SED-CSC-S3-0.2FT	Beryllium	mg/kg dw	1	B	1.5
10/4/99	SED-CSD-S1-0.2FT	Beryllium	mg/kg dw	1.2	B	1.7
10/4/99	SED-CSD-S2-0.2FT	Beryllium	mg/kg dw	1.3	B	1.9
10/4/99	SED-CSD-S3-0.2FT	Beryllium	mg/kg dw	1	B	1.2
10/6/99	SED-CSE-S1-0.2FT	Beryllium	mg/kg dw	0.84	B	1.4
10/6/99	SED-CSE-S2-0.2FT	Beryllium	mg/kg dw	0.75	B	1.1
10/6/99	SED-CSE-S3-0.2FT	Beryllium	mg/kg dw	0.9	B	1.3
10/5/99	SED-M-S1-0.2FT	Beryllium	mg/kg dw	1.3	B	2
10/5/99	SED-CSB-S1-0.2FT	Cadmium	mg/kg dw	17		1.3
10/5/99	SED-CSB-S2-0.2FT	Cadmium	mg/kg dw	25		1.3
10/5/99	SED-CSB-S3-0.2FT	Cadmium	mg/kg dw	25		1.7
10/4/99	SED-CSC-S1-0.2FT	Cadmium	mg/kg dw	20		1.7
10/4/99	SED-CSC-S2-0.2FT	Cadmium	mg/kg dw	19		1.4
10/4/99	SED-CSC-S3-0.2FT	Cadmium	mg/kg dw	16		1.9
10/4/99	SED-CSD-S1-0.2FT	Cadmium	mg/kg dw	15		2.2
10/4/99	SED-CSD-S2-0.2FT	Cadmium	mg/kg dw	13		2.4
10/4/99	SED-CSD-S3-0.2FT	Cadmium	mg/kg dw	10		1.5
10/6/99	SED-CSE-S1-0.2FT	Cadmium	mg/kg dw	14		2
10/6/99	SED-CSE-S2-0.2FT	Cadmium	mg/kg dw	11		1.3
10/6/99	SED-CSE-S3-0.2FT	Cadmium	mg/kg dw	7.7		1.7
10/5/99	SED-M-S1-0.2FT	Cadmium	mg/kg dw	17		2.5
10/5/99	SED-CSB-S1-0.2FT	Calcium	mg/kg dw	180,000		125
10/5/99	SED-CSB-S2-0.2FT	Calcium	mg/kg dw	87,000		125
10/5/99	SED-CSB-S3-0.2FT	Calcium	mg/kg dw	100,000		166.7
10/4/99	SED-CSC-S1-0.2FT	Calcium	mg/kg dw	28,000		172
10/4/99	SED-CSC-S2-0.2FT	Calcium	mg/kg dw	23,000		143
10/4/99	SED-CSC-S3-0.2FT	Calcium	mg/kg dw	47,000		192.3

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/4/99	SED-CSD-S1-0.2FT	Calcium	mg/kg dw	28,000		217
10/4/99	SED-CSD-S2-0.2FT	Calcium	mg/kg dw	30,000		238
10/4/99	SED-CSD-S3-0.2FT	Calcium	mg/kg dw	26,000		147
10/6/99	SED-CSE-S1-0.2FT	Calcium	mg/kg dw	43,000		179
10/6/99	SED-CSE-S2-0.2FT	Calcium	mg/kg dw	80,000		132
10/6/99	SED-CSE-S3-0.2FT	Calcium	mg/kg dw	26,000		166.7
10/5/99	SED-M-S1-0.2FT	Calcium	mg/kg dw	100,000		250
10/5/99	SED-CSB-S1-0.2FT	Chromium	mg/kg dw	49		2.5
10/5/99	SED-CSB-S2-0.2FT	Chromium	mg/kg dw	76		2.5
10/5/99	SED-CSB-S3-0.2FT	Chromium	mg/kg dw	78		3.3
10/4/99	SED-CSC-S1-0.2FT	Chromium	mg/kg dw	50		3.4
10/4/99	SED-CSC-S2-0.2FT	Chromium	mg/kg dw	93		2.9
10/4/99	SED-CSC-S3-0.2FT	Chromium	mg/kg dw	47		3.8
10/4/99	SED-CSD-S1-0.2FT	Chromium	mg/kg dw	56		4.3
10/4/99	SED-CSD-S2-0.2FT	Chromium	mg/kg dw	60		4.8
10/4/99	SED-CSD-S3-0.2FT	Chromium	mg/kg dw	67		2.9
10/6/99	SED-CSE-S1-0.2FT	Chromium	mg/kg dw	71		4
10/6/99	SED-CSE-S2-0.2FT	Chromium	mg/kg dw	49		3
10/6/99	SED-CSE-S3-0.2FT	Chromium	mg/kg dw	31		3.3
10/5/99	SED-M-S1-0.2FT	Chromium	mg/kg dw	48		5
10/5/99	SED-CSB-S1-0.2FT	Cobalt	mg/kg dw	7.2		2.5
10/5/99	SED-CSB-S2-0.2FT	Cobalt	mg/kg dw	9.9		2.5
10/5/99	SED-CSB-S3-0.2FT	Cobalt	mg/kg dw	12		3.3
10/4/99	SED-CSC-S1-0.2FT	Cobalt	mg/kg dw	17		3.4
10/4/99	SED-CSC-S2-0.2FT	Cobalt	mg/kg dw	12		2.9
10/4/99	SED-CSC-S3-0.2FT	Cobalt	mg/kg dw	9.7		3.8
10/4/99	SED-CSD-S1-0.2FT	Cobalt	mg/kg dw	12		4.3
10/4/99	SED-CSD-S2-0.2FT	Cobalt	mg/kg dw	12		4.8
10/4/99	SED-CSD-S3-0.2FT	Cobalt	mg/kg dw	8.8		2.9
10/6/99	SED-CSE-S1-0.2FT	Cobalt	mg/kg dw	10		4
10/6/99	SED-CSE-S2-0.2FT	Cobalt	mg/kg dw	9.2		3
10/6/99	SED-CSE-S3-0.2FT	Cobalt	mg/kg dw	7.4		3.3
10/5/99	SED-M-S1-0.2FT	Cobalt	mg/kg dw	15		5
10/5/99	SED-CSB-S1-0.2FT	Copper	mg/kg dw	5,100		5
10/5/99	SED-CSB-S2-0.2FT	Copper	mg/kg dw	11,000		5
10/5/99	SED-CSB-S3-0.2FT	Copper	mg/kg dw	6,700		6.7
10/4/99	SED-CSC-S1-0.2FT	Copper	mg/kg dw	1,400		6.9
10/4/99	SED-CSC-S2-0.2FT	Copper	mg/kg dw	2,200		5.7
10/4/99	SED-CSC-S3-0.2FT	Copper	mg/kg dw	2,100		7.7
10/4/99	SED-CSD-S1-0.2FT	Copper	mg/kg dw	740		8.7
10/4/99	SED-CSD-S2-0.2FT	Copper	mg/kg dw	730		9.5
10/4/99	SED-CSD-S3-0.2FT	Copper	mg/kg dw	320		5.9
10/6/99	SED-CSE-S1-0.2FT	Copper	mg/kg dw	570		7
10/6/99	SED-CSE-S2-0.2FT	Copper	mg/kg dw	350		5
10/6/99	SED-CSE-S3-0.2FT	Copper	mg/kg dw	150		6.7
10/5/99	SED-M-S1-0.2FT	Copper	mg/kg dw	4,200		10
10/5/99	SED-CSB-S1-0.2FT	Iron	mg/kg dw	14,000		12.5
10/5/99	SED-CSB-S2-0.2FT	Iron	mg/kg dw	29,000		12.5
10/5/99	SED-CSB-S3-0.2FT	Iron	mg/kg dw	25,000		16.7
10/4/99	SED-CSC-S1-0.2FT	Iron	mg/kg dw	27,000		17
10/4/99	SED-CSC-S2-0.2FT	Iron	mg/kg dw	21,000		14
10/4/99	SED-CSC-S3-0.2FT	Iron	mg/kg dw	24,000		19
10/4/99	SED-CSD-S1-0.2FT	Iron	mg/kg dw	22,000		21.7
10/4/99	SED-CSD-S2-0.2FT	Iron	mg/kg dw	25,000		24
10/4/99	SED-CSD-S3-0.2FT	Iron	mg/kg dw	19,000		15
10/6/99	SED-CSE-S1-0.2FT	Iron	mg/kg dw	24,000		18
10/6/99	SED-CSE-S2-0.2FT	Iron	mg/kg dw	20,000		13

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/6/99	SED-CSE-S3-0.2FT	Iron	mg/kg dw	17,000		16.7
10/5/99	SED-M-S1-0.2FT	Iron	mg/kg dw	34,000		25
10/5/99	SED-CSB-S1-0.2FT	Lead	mg/kg dw	630		1.3
10/5/99	SED-CSB-S2-0.2FT	Lead	mg/kg dw	1,000		1.3
10/5/99	SED-CSB-S3-0.2FT	Lead	mg/kg dw	750		1.7
10/4/99	SED-CSC-S1-0.2FT	Lead	mg/kg dw	270		1.7
10/4/99	SED-CSC-S2-0.2FT	Lead	mg/kg dw	330		1.4
10/4/99	SED-CSC-S3-0.2FT	Lead	mg/kg dw	480		1.9
10/4/99	SED-CSD-S1-0.2FT	Lead	mg/kg dw	260		2
10/4/99	SED-CSD-S2-0.2FT	Lead	mg/kg dw	230		2.4
10/4/99	SED-CSD-S3-0.2FT	Lead	mg/kg dw	170		1.5
10/6/99	SED-CSE-S1-0.2FT	Lead	mg/kg dw	310		2
10/6/99	SED-CSE-S2-0.2FT	Lead	mg/kg dw	190		1.3
10/6/99	SED-CSE-S3-0.2FT	Lead	mg/kg dw	140		1.7
10/5/99	SED-M-S1-0.2FT	Lead	mg/kg dw	530		2.5
10/5/99	SED-CSB-S1-0.2FT	Magnesium	mg/kg dw	20,000		125
10/5/99	SED-CSB-S2-0.2FT	Magnesium	mg/kg dw	10,000		125
10/5/99	SED-CSB-S3-0.2FT	Magnesium	mg/kg dw	11,000		166.7
10/4/99	SED-CSC-S1-0.2FT	Magnesium	mg/kg dw	5,500		172
10/4/99	SED-CSC-S2-0.2FT	Magnesium	mg/kg dw	3,600		143
10/4/99	SED-CSC-S3-0.2FT	Magnesium	mg/kg dw	6,400		192
10/4/99	SED-CSD-S1-0.2FT	Magnesium	mg/kg dw	6,700		217
10/4/99	SED-CSD-S2-0.2FT	Magnesium	mg/kg dw	7,500		238
10/4/99	SED-CSD-S3-0.2FT	Magnesium	mg/kg dw	6,600		147
10/6/99	SED-CSE-S1-0.2FT	Magnesium	mg/kg dw	9,200		179
10/6/99	SED-CSE-S2-0.2FT	Magnesium	mg/kg dw	13,000		132
10/6/99	SED-CSE-S3-0.2FT	Magnesium	mg/kg dw	7,400		166.7
10/5/99	SED-M-S1-0.2FT	Magnesium	mg/kg dw	7,400		250
10/5/99	SED-CSB-S1-0.2FT	Manganese	mg/kg dw	250		2.5
10/5/99	SED-CSB-S2-0.2FT	Manganese	mg/kg dw	210		2.5
10/5/99	SED-CSB-S3-0.2FT	Manganese	mg/kg dw	230		3.3
10/4/99	SED-CSC-S1-0.2FT	Manganese	mg/kg dw	290		3.4
10/4/99	SED-CSC-S2-0.2FT	Manganese	mg/kg dw	240		2.9
10/4/99	SED-CSC-S3-0.2FT	Manganese	mg/kg dw	330		3.8
10/4/99	SED-CSD-S1-0.2FT	Manganese	mg/kg dw	250		4.3
10/4/99	SED-CSD-S2-0.2FT	Manganese	mg/kg dw	320		4.8
10/4/99	SED-CSD-S3-0.2FT	Manganese	mg/kg dw	270		2.9
10/6/99	SED-CSE-S1-0.2FT	Manganese	mg/kg dw	310		4
10/6/99	SED-CSE-S2-0.2FT	Manganese	mg/kg dw	320		3
10/6/99	SED-CSE-S3-0.2FT	Manganese	mg/kg dw	170		3.3
10/5/99	SED-M-S1-0.2FT	Manganese	mg/kg dw	370		5
10/5/99	SED-CSB-S1-0.2FT	Mercury	mg/kg dw	0.96	N	0.3
10/5/99	SED-CSB-S2-0.2FT	Mercury	mg/kg dw	1.5	N	0.5
10/5/99	SED-CSB-S3-0.2FT	Mercury	mg/kg dw	1.4	N	0.3
10/4/99	SED-CSC-S1-0.2FT	Mercury	mg/kg dw	0.66	N	0.1
10/4/99	SED-CSC-S2-0.2FT	Mercury	mg/kg dw	0.64	N	0.3
10/4/99	SED-CSC-S3-0.2FT	Mercury	mg/kg dw	0.58	N	0.1
10/4/99	SED-CSD-S1-0.2FT	Mercury	mg/kg dw	0.5	N	0.1
10/4/99	SED-CSD-S2-0.2FT	Mercury	mg/kg dw	0.42	N	0.1
10/4/99	SED-CSD-S3-0.2FT	Mercury	mg/kg dw	0.35	N	0.1
10/6/99	SED-CSE-S1-0.2FT	Mercury	mg/kg dw	0.51		0.071
10/6/99	SED-CSE-S2-0.2FT	Mercury	mg/kg dw	0.3		0.053
10/6/99	SED-CSE-S3-0.2FT	Mercury	mg/kg dw	0.3	N	0.1
10/5/99	SED-M-S1-0.2FT	Mercury	mg/kg dw	1	N	0.1
10/5/99	SED-CSB-S1-0.2FT	Molybdenum	mg/kg dw	7.2		2.5
10/5/99	SED-CSB-S2-0.2FT	Molybdenum	mg/kg dw	4.3		2.5
10/5/99	SED-CSB-S3-0.2FT	Molybdenum	mg/kg dw	4.8		3.3

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Saugat Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/4/99	SED-CSC-S1-0.2FT	Molybdenum	mg/kg dw	3.4		3.4
10/4/99	SED-CSC-S2-0.2FT	Molybdenum	mg/kg dw	2.2	B	2.9
10/4/99	SED-CSC-S3-0.2FT	Molybdenum	mg/kg dw	1.7	B	3.8
10/4/99	SED-CSD-S1-0.2FT	Molybdenum	mg/kg dw	3	B	4.3
10/4/99	SED-CSD-S2-0.2FT	Molybdenum	mg/kg dw	2.6	B	4.8
10/4/99	SED-CSD-S3-0.2FT	Molybdenum	mg/kg dw	1.7	B	2.9
10/6/99	SED-CSE-S1-0.2FT	Molybdenum	mg/kg dw	2.6	B	4
10/6/99	SED-CSE-S2-0.2FT	Molybdenum	mg/kg dw	1.6	B	3
10/6/99	SED-CSE-S3-0.2FT	Molybdenum	mg/kg dw	3.2		3.3
10/5/99	SED-M-S1-0.2FT	Molybdenum	mg/kg dw	17		5
10/5/99	SED-CSB-S1-0.2FT	Nickel	mg/kg dw	88		10
10/5/99	SED-CSB-S2-0.2FT	Nickel	mg/kg dw	500		10
10/5/99	SED-CSB-S3-0.2FT	Nickel	mg/kg dw	380		13.3
10/4/99	SED-CSC-S1-0.2FT	Nickel	mg/kg dw	370		14
10/4/99	SED-CSC-S2-0.2FT	Nickel	mg/kg dw	580		11
10/4/99	SED-CSC-S3-0.2FT	Nickel	mg/kg dw	550		15
10/4/99	SED-CSD-S1-0.2FT	Nickel	mg/kg dw	260		17
10/4/99	SED-CSD-S2-0.2FT	Nickel	mg/kg dw	260		19
10/4/99	SED-CSD-S3-0.2FT	Nickel	mg/kg dw	150		12
10/6/99	SED-CSE-S1-0.2FT	Nickel	mg/kg dw	190		14
10/6/99	SED-CSE-S2-0.2FT	Nickel	mg/kg dw	130		11
10/6/99	SED-CSE-S3-0.2FT	Nickel	mg/kg dw	51		13.3
10/5/99	SED-M-S1-0.2FT	Nickel	mg/kg dw	190		20
10/5/99	SED-CSB-S1-0.2FT	pH	su	6.77		
10/5/99	SED-CSB-S2-0.2FT	pH	su	6.64		
10/5/99	SED-CSB-S3-0.2FT	pH	su	6.6		
10/4/99	SED-CSC-S1-0.2FT	pH	su	6.87		
10/4/99	SED-CSC-S2-0.2FT	pH	su	6.92		
10/4/99	SED-CSC-S3-0.2FT	pH	su	6.78		
10/4/99	SED-CSD-S1-0.2FT	pH	su	6.84		
10/4/99	SED-CSD-S2-0.2FT	pH	su	6.82		
10/4/99	SED-CSD-S3-0.2FT	pH	su	6.75		
10/6/99	SED-CSE-S1-0.2FT	pH	su	6.7		
10/6/99	SED-CSE-S2-0.2FT	pH	su	6.83		
10/6/99	SED-CSE-S3-0.2FT	pH	su	6.78		
10/5/99	SED-M-S1-0.2FT	pH	su	6.81		
10/5/99	SED-CSB-S1-0.2FT	Potassium	mg/kg dw	1,700	N	250
10/5/99	SED-CSB-S2-0.2FT	Potassium	mg/kg dw	1,700	N	250
10/5/99	SED-CSB-S3-0.2FT	Potassium	mg/kg dw	2,400	N	333.3
10/4/99	SED-CSC-S1-0.2FT	Potassium	mg/kg dw	3,000	N	345
10/4/99	SED-CSC-S2-0.2FT	Potassium	mg/kg dw	2,400	N	286
10/4/99	SED-CSC-S3-0.2FT	Potassium	mg/kg dw	2,100	N	385
10/4/99	SED-CSD-S1-0.2FT	Potassium	mg/kg dw	2,900	N	435
10/4/99	SED-CSD-S2-0.2FT	Potassium	mg/kg dw	3,200	N	476
10/4/99	SED-CSD-S3-0.2FT	Potassium	mg/kg dw	2,700	N	294
10/6/99	SED-CSE-S1-0.2FT	Potassium	mg/kg dw	3,100	N	357
10/6/99	SED-CSE-S2-0.2FT	Potassium	mg/kg dw	2,600	N	263
10/6/99	SED-CSE-S3-0.2FT	Potassium	mg/kg dw	2,400	N	333.3
10/5/99	SED-M-S1-0.2FT	Potassium	mg/kg dw	2,000	N	500
10/5/99	SED-CSB-S1-0.2FT	Selenium	mg/kg dw	4.1		2.5
10/5/99	SED-CSB-S2-0.2FT	Selenium	mg/kg dw	5.1	B	12.5
10/5/99	SED-CSB-S3-0.2FT	Selenium	mg/kg dw	3.5	B	6.7
10/4/99	SED-CSC-S1-0.2FT	Selenium	mg/kg dw	2.8	B	3.4
10/4/99	SED-CSC-S2-0.2FT	Selenium	mg/kg dw	13	U	13
10/4/99	SED-CSC-S3-0.2FT	Selenium	mg/kg dw	2.4	B	3.8
10/4/99	SED-CSD-S1-0.2FT	Selenium	mg/kg dw	2	B	4.3
10/4/99	SED-CSD-S2-0.2FT	Selenium	mg/kg dw	2.5	B	4.8

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/4/99	SED-CSD-S3-0.2FT	Selenium	mg/kg dw	2.9	U	2.9
10/6/99	SED-CSE-S1-0.2FT	Selenium	mg/kg dw	2.6	B	4
10/6/99	SED-CSE-S2-0.2FT	Selenium	mg/kg dw	1.5	B	3
10/6/99	SED-CSE-S3-0.2FT	Selenium	mg/kg dw	3	U	3
10/5/99	SED-M-S1-0.2FT	Selenium	mg/kg dw	3.8	B	5
10/5/99	SED-CSB-S1-0.2FT	Silver	mg/kg dw	6.7		2.5
10/5/99	SED-CSB-S2-0.2FT	Silver	mg/kg dw	15		2.5
10/5/99	SED-CSB-S3-0.2FT	Silver	mg/kg dw	8.9		3.3
10/4/99	SED-CSC-S1-0.2FT	Silver	mg/kg dw	1.2	B	3.4
10/4/99	SED-CSC-S2-0.2FT	Silver	mg/kg dw	1.8	B	2.9
10/4/99	SED-CSC-S3-0.2FT	Silver	mg/kg dw	1.6	B	3.8
10/4/99	SED-CSD-S1-0.2FT	Silver	mg/kg dw	4.3	U	4.3
10/4/99	SED-CSD-S2-0.2FT	Silver	mg/kg dw	4.3	U	4.3
10/4/99	SED-CSD-S3-0.2FT	Silver	mg/kg dw	2.9	U	2.9
10/6/99	SED-CSE-S1-0.2FT	Silver	mg/kg dw	1.1	B	4
10/6/99	SED-CSE-S2-0.2FT	Silver	mg/kg dw	0.67	B	3
10/6/99	SED-CSE-S3-0.2FT	Silver	mg/kg dw	3	U	3
10/5/99	SED-M-S1-0.2FT	Silver	mg/kg dw	7.3		5
10/5/99	SED-CSB-S1-0.2FT	Sodium	mg/kg dw	340		125
10/5/99	SED-CSB-S2-0.2FT	Sodium	mg/kg dw	270		125
10/5/99	SED-CSB-S3-0.2FT	Sodium	mg/kg dw	290		166.7
10/4/99	SED-CSC-S1-0.2FT	Sodium	mg/kg dw	300		172
10/4/99	SED-CSC-S2-0.2FT	Sodium	mg/kg dw	320		143
10/4/99	SED-CSC-S3-0.2FT	Sodium	mg/kg dw	340		192
10/4/99	SED-CSD-S1-0.2FT	Sodium	mg/kg dw	240		217
10/4/99	SED-CSD-S2-0.2FT	Sodium	mg/kg dw	250		238
10/4/99	SED-CSD-S3-0.2FT	Sodium	mg/kg dw	190		147
10/6/99	SED-CSE-S1-0.2FT	Sodium	mg/kg dw	250		179
10/6/99	SED-CSE-S2-0.2FT	Sodium	mg/kg dw	300		132
10/6/99	SED-CSE-S3-0.2FT	Sodium	mg/kg dw	180		166.7
10/5/99	SED-M-S1-0.2FT	Sodium	mg/kg dw	290		250
10/5/99	SED-CSB-S1-0.2FT	Thallium	mg/kg dw	2.5	U	2.5
10/5/99	SED-CSB-S2-0.2FT	Thallium	mg/kg dw	2.3	U	2.3
10/5/99	SED-CSB-S3-0.2FT	Thallium	mg/kg dw	2.1	B	3.3
10/4/99	SED-CSC-S1-0.2FT	Thallium	mg/kg dw	3.1	U	3.1
10/4/99	SED-CSC-S2-0.2FT	Thallium	mg/kg dw	2.6	U	2.6
10/4/99	SED-CSC-S3-0.2FT	Thallium	mg/kg dw	3.5	U	3.5
10/4/99	SED-CSD-S1-0.2FT	Thallium	mg/kg dw	4.3	U	4.3
10/4/99	SED-CSD-S2-0.2FT	Thallium	mg/kg dw	4.3	U	4.3
10/4/99	SED-CSD-S3-0.2FT	Thallium	mg/kg dw	2.9	U	2.9
10/6/99	SED-CSE-S1-0.2FT	Thallium	mg/kg dw	1.9	B	4
10/6/99	SED-CSE-S2-0.2FT	Thallium	mg/kg dw	2.6	U	3
10/6/99	SED-CSE-S3-0.2FT	Thallium	mg/kg dw	3	U	3
10/5/99	SED-M-S1-0.2FT	Thallium	mg/kg dw	5	U	5
	SED-CSB-S1-0.2FT	Tin	mg/kg dw	NA		
	SED-CSB-S2-0.2FT	Tin	mg/kg dw	NA		
	SED-CSB-S3-0.2FT	Tin	mg/kg dw	NA		
	SED-CSC-S1-0.2FT	Tin	mg/kg dw	NA		
	SED-CSC-S2-0.2FT	Tin	mg/kg dw	NA		
	SED-CSC-S3-0.2FT	Tin	mg/kg dw	NA		
	SED-CSD-S1-0.2FT	Tin	mg/kg dw	NA		
	SED-CSD-S2-0.2FT	Tin	mg/kg dw	NA		
	SED-CSD-S3-0.2FT	Tin	mg/kg dw	NA		
10/6/99	SED-CSE-S1-0.2FT	Tin	mg/kg dw	19		NA
10/6/99	SED-CSE-S2-0.2FT	Tin	mg/kg dw	12		NA
	SED-CSE-S3-0.2FT	Tin	mg/kg dw	NA		
	SED-M-S1-0.2FT	Tin	mg/kg dw	NA		

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/5/99	SED-CSB-S1-0.2FT	Vanadium	mg/kg dw	29		2.5
10/5/99	SED-CSB-S2-0.2FT	Vanadium	mg/kg dw	37		2.5
10/5/99	SED-CSB-S3-0.2FT	Vanadium	mg/kg dw	41		3.3
10/4/99	SED-CSC-S1-0.2FT	Vanadium	mg/kg dw	48		3.4
10/4/99	SED-CSC-S2-0.2FT	Vanadium	mg/kg dw	36		2.9
10/4/99	SED-CSC-S3-0.2FT	Vanadium	mg/kg dw	34		3.8
10/4/99	SED-CSD-S1-0.2FT	Vanadium	mg/kg dw	44		4.3
10/4/99	SED-CSD-S2-0.2FT	Vanadium	mg/kg dw	51		4.8
10/4/99	SED-CSD-S3-0.2FT	Vanadium	mg/kg dw	37		2.9
10/6/99	SED-CSE-S1-0.2FT	Vanadium	mg/kg dw	51		4
10/6/99	SED-CSE-S2-0.2FT	Vanadium	mg/kg dw	40		3
10/6/99	SED-CSE-S3-0.2FT	Vanadium	mg/kg dw	37		3.3
10/5/99	SED-M-S1-0.2FT	Vanadium	mg/kg dw	45		5
10/5/99	SED-CSB-S1-0.2FT	Zinc	mg/kg dw	2,000		5
10/5/99	SED-CSB-S2-0.2FT	Zinc	mg/kg dw	7,900		25
10/5/99	SED-CSB-S3-0.2FT	Zinc	mg/kg dw	4,800		13.3
10/4/99	SED-CSC-S1-0.2FT	Zinc	mg/kg dw	2,900		6.9
10/4/99	SED-CSC-S2-0.2FT	Zinc	mg/kg dw	4,500		29
10/4/99	SED-CSC-S3-0.2FT	Zinc	mg/kg dw	3,300		7.7
10/4/99	SED-CSD-S1-0.2FT	Zinc	mg/kg dw	2,500		8.7
10/4/99	SED-CSD-S2-0.2FT	Zinc	mg/kg dw	2,700		9.5
10/4/99	SED-CSD-S3-0.2FT	Zinc	mg/kg dw	1,800		5.9
10/6/99	SED-CSE-S1-0.2FT	Zinc	mg/kg dw	2,300	E	7
10/6/99	SED-CSE-S2-0.2FT	Zinc	mg/kg dw	1,800	E	5
10/6/99	SED-CSE-S3-0.2FT	Zinc	mg/kg dw	980		6.7
10/5/99	SED-M-S1-0.2FT	Zinc	mg/kg dw	2,400		10
SVOCs						
10/5/99	SED-CSB-S1-0.2FT	1,2,4-Trichlorobenzene	ug/kg dw	2,600	U	2,600
10/5/99	SED-CSB-S2-0.2FT	1,2,4-Trichlorobenzene	ug/kg dw	770	J	425
10/5/99	SED-CSB-S3-0.2FT	1,2,4-Trichlorobenzene	ug/kg dw	3,300	U	3,300
10/4/99	SED-CSC-S1-0.2FT	1,2,4-Trichlorobenzene	ug/kg dw	3,400	U	3,400
10/4/99	SED-CSC-S2-0.2FT	1,2,4-Trichlorobenzene	ug/kg dw	2,800	U	2,800
10/4/99	SED-CSC-S3-0.2FT	1,2,4-Trichlorobenzene	ug/kg dw	3,900	U	3,900
10/4/99	SED-CSD-S1-0.2FT	1,2,4-Trichlorobenzene	ug/kg dw	4,300	U	4,300
10/4/99	SED-CSD-S2-0.2FT	1,2,4-Trichlorobenzene	ug/kg dw	4,700	U	4,700
10/4/99	SED-CSD-S3-0.2FT	1,2,4-Trichlorobenzene	ug/kg dw	2,900	U	2,900
10/6/99	SED-CSE-S1-0.2FT	1,2,4-Trichlorobenzene	ug/kg dw	600	U	600
10/6/99	SED-CSE-S2-0.2FT	1,2,4-Trichlorobenzene	ug/kg dw	440	U	440
10/6/99	SED-CSE-S3-0.2FT	1,2,4-Trichlorobenzene	ug/kg dw	560	U	560
10/5/99	SED-M-S1-0.2FT	1,2,4-Trichlorobenzene	ug/kg dw	5,000	U	5,000
10/5/99	SED-CSB-S1-0.2FT	1,2-Dichlorobenzene	ug/kg dw	370	J	425
10/5/99	SED-CSB-S2-0.2FT	1,2-Dichlorobenzene	ug/kg dw	2,600	U	2,600
10/5/99	SED-CSB-S3-0.2FT	1,2-Dichlorobenzene	ug/kg dw	3,300	U	3,300
10/4/99	SED-CSC-S1-0.2FT	1,2-Dichlorobenzene	ug/kg dw	3,400	U	3,400
10/4/99	SED-CSC-S2-0.2FT	1,2-Dichlorobenzene	ug/kg dw	2,800	U	2,800
10/4/99	SED-CSC-S3-0.2FT	1,2-Dichlorobenzene	ug/kg dw	3,900	U	3,900
10/4/99	SED-CSD-S1-0.2FT	1,2-Dichlorobenzene	ug/kg dw	4,300	U	4,300
10/4/99	SED-CSD-S2-0.2FT	1,2-Dichlorobenzene	ug/kg dw	4,700	U	4,700
10/4/99	SED-CSD-S3-0.2FT	1,2-Dichlorobenzene	ug/kg dw	2,900	U	2,900
10/6/99	SED-CSE-S1-0.2FT	1,2-Dichlorobenzene	ug/kg dw	600	U	600
10/6/99	SED-CSE-S2-0.2FT	1,2-Dichlorobenzene	ug/kg dw	440	U	440
10/6/99	SED-CSE-S3-0.2FT	1,2-Dichlorobenzene	ug/kg dw	560	U	560
10/5/99	SED-M-S1-0.2FT	1,2-Dichlorobenzene	ug/kg dw	5,000	U	5,000
10/5/99	SED-CSB-S1-0.2FT	1,4-Dichlorobenzene	ug/kg dw	1,000	J	425
10/5/99	SED-CSB-S2-0.2FT	1,4-Dichlorobenzene	ug/kg dw	520	J	425
10/5/99	SED-CSB-S3-0.2FT	1,4-Dichlorobenzene	ug/kg dw	3,300	U	3,300
10/4/99	SED-CSC-S1-0.2FT	1,4-Dichlorobenzene	ug/kg dw	3,400	U	3,400

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/4/99	SED-CSC-S2-0.2FT	1,4-Dichlorobenzene	ug/kg dw	2,800	U	2,800
10/4/99	SED-CSC-S3-0.2FT	1,4-Dichlorobenzene	ug/kg dw	3,900	U	3,900
10/4/99	SED-CSD-S1-0.2FT	1,4-Dichlorobenzene	ug/kg dw	4,300	U	4,300
10/4/99	SED-CSD-S2-0.2FT	1,4-Dichlorobenzene	ug/kg dw	4,700	U	4,700
10/4/99	SED-CSD-S3-0.2FT	1,4-Dichlorobenzene	ug/kg dw	2,900	U	2,900
10/6/99	SED-CSE-S1-0.2FT	1,4-Dichlorobenzene	ug/kg dw	600	U	600
10/6/99	SED-CSE-S2-0.2FT	1,4-Dichlorobenzene	ug/kg dw	440	U	440
10/6/99	SED-CSE-S3-0.2FT	1,4-Dichlorobenzene	ug/kg dw	560	U	560
10/5/99	SED-M-S1-0.2FT	1,4-Dichlorobenzene	ug/kg dw	5,000	U	5,000
10/5/99	SED-CSB-S1-0.2FT	4-Chloroaniline	ug/kg dw	5,000	U	5,000
10/5/99	SED-CSB-S2-0.2FT	4-Chloroaniline	ug/kg dw	830	J	825
10/5/99	SED-CSB-S3-0.2FT	4-Chloroaniline	ug/kg dw	6,300	U	6,300
10/4/99	SED-CSC-S1-0.2FT	4-Chloroaniline	ug/kg dw	6,600	U	6,600
10/4/99	SED-CSC-S2-0.2FT	4-Chloroaniline	ug/kg dw	5,500	U	5,500
10/4/99	SED-CSC-S3-0.2FT	4-Chloroaniline	ug/kg dw	7,600	U	7,600
10/4/99	SED-CSD-S1-0.2FT	4-Chloroaniline	ug/kg dw	8,400	U	8,400
10/4/99	SED-CSD-S2-0.2FT	4-Chloroaniline	ug/kg dw	9,100	U	9,100
10/4/99	SED-CSD-S3-0.2FT	4-Chloroaniline	ug/kg dw	5,700	U	5,700
10/6/99	SED-CSE-S1-0.2FT	4-Chloroaniline	ug/kg dw	1,200	U	1,200
10/6/99	SED-CSE-S2-0.2FT	4-Chloroaniline	ug/kg dw	860	U	860
10/6/99	SED-CSE-S3-0.2FT	4-Chloroaniline	ug/kg dw	1,100	U	1,100
10/5/99	SED-M-S1-0.2FT	4-Chloroaniline	ug/kg dw	2,400	J	1,650
10/5/99	SED-CSB-S1-0.2FT	Benzo(a)anthracene	ug/kg dw	960	J	425
10/5/99	SED-CSB-S2-0.2FT	Benzo(a)anthracene	ug/kg dw	870	J	425
10/5/99	SED-CSB-S3-0.2FT	Benzo(a)anthracene	ug/kg dw	680	J	566.7
10/4/99	SED-CSC-S1-0.2FT	Benzo(a)anthracene	ug/kg dw	530	J	586
10/4/99	SED-CSC-S2-0.2FT	Benzo(a)anthracene	ug/kg dw	2,800	U	2,800
10/4/99	SED-CSC-S3-0.2FT	Benzo(a)anthracene	ug/kg dw	890	J	654
10/4/99	SED-CSD-S1-0.2FT	Benzo(a)anthracene	ug/kg dw	4,300	U	4,300
10/4/99	SED-CSD-S2-0.2FT	Benzo(a)anthracene	ug/kg dw	4,700	U	4,700
10/4/99	SED-CSD-S3-0.2FT	Benzo(a)anthracene	ug/kg dw	420	J	500
10/6/99	SED-CSE-S1-0.2FT	Benzo(a)anthracene	ug/kg dw	100	J	607
10/6/99	SED-CSE-S2-0.2FT	Benzo(a)anthracene	ug/kg dw	120	J	447
10/6/99	SED-CSE-S3-0.2FT	Benzo(a)anthracene	ug/kg dw	340	J	566.7
10/5/99	SED-M-S1-0.2FT	Benzo(a)anthracene	ug/kg dw	1,300	J	850
10/5/99	SED-CSB-S1-0.2FT	Benzo(a)pyrene	ug/kg dw	1,500		225
10/5/99	SED-CSB-S2-0.2FT	Benzo(a)pyrene	ug/kg dw	1,200	J	225
10/5/99	SED-CSB-S3-0.2FT	Benzo(a)pyrene	ug/kg dw	730	J	300
10/4/99	SED-CSC-S1-0.2FT	Benzo(a)pyrene	ug/kg dw	1,800	U	1,800
10/4/99	SED-CSC-S2-0.2FT	Benzo(a)pyrene	ug/kg dw	1,500	U	1,500
10/4/99	SED-CSC-S3-0.2FT	Benzo(a)pyrene	ug/kg dw	1,400	J	346
10/4/99	SED-CSD-S1-0.2FT	Benzo(a)pyrene	ug/kg dw	2,300	U	2,300
10/4/99	SED-CSD-S2-0.2FT	Benzo(a)pyrene	ug/kg dw	2,500	U	2,500
10/4/99	SED-CSD-S3-0.2FT	Benzo(a)pyrene	ug/kg dw	560	J	265
10/6/99	SED-CSE-S1-0.2FT	Benzo(a)pyrene	ug/kg dw	150	J	321
10/6/99	SED-CSE-S2-0.2FT	Benzo(a)pyrene	ug/kg dw	170	J	237
10/6/99	SED-CSE-S3-0.2FT	Benzo(a)pyrene	ug/kg dw	420		300
10/5/99	SED-M-S1-0.2FT	Benzo(a)pyrene	ug/kg dw	1,500	J	450
10/5/99	SED-CSB-S1-0.2FT	Benzo(b)fluoranthene	ug/kg dw	1,700	J	425
10/5/99	SED-CSB-S2-0.2FT	Benzo(b)fluoranthene	ug/kg dw	2,000	J	425
10/5/99	SED-CSB-S3-0.2FT	Benzo(b)fluoranthene	ug/kg dw	1,100	J	566.7
10/4/99	SED-CSC-S1-0.2FT	Benzo(b)fluoranthene	ug/kg dw	680	J	586
10/4/99	SED-CSC-S2-0.2FT	Benzo(b)fluoranthene	ug/kg dw	600	J	486
10/4/99	SED-CSC-S3-0.2FT	Benzo(b)fluoranthene	ug/kg dw	2,000	J	654
10/4/99	SED-CSD-S1-0.2FT	Benzo(b)fluoranthene	ug/kg dw	970	J	739
10/4/99	SED-CSD-S2-0.2FT	Benzo(b)fluoranthene	ug/kg dw	780	J	810
10/4/99	SED-CSD-S3-0.2FT	Benzo(b)fluoranthene	ug/kg dw	910	J	500

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/6/99	SED-CSE-S1-0.2FT	Benzo(b)fluoranthene	ug/kg dw	170	J	607
10/6/99	SED-CSE-S2-0.2FT	Benzo(b)fluoranthene	ug/kg dw	260	J	447
10/6/99	SED-CSE-S3-0.2FT	Benzo(b)fluoranthene	ug/kg dw	520	J	566.7
10/5/99	SED-M-S1-0.2FT	Benzo(b)fluoranthene	ug/kg dw	1,500	J	850
10/5/99	SED-CSB-S1-0.2FT	Benzo(g,h,i)perylene	ug/kg dw	1,600	J	425
10/5/99	SED-CSB-S2-0.2FT	Benzo(g,h,i)perylene	ug/kg dw	1,600	J	425
10/5/99	SED-CSB-S3-0.2FT	Benzo(g,h,i)perylene	ug/kg dw	790	J	566.7
10/4/99	SED-CSC-S1-0.2FT	Benzo(g,h,i)perylene	ug/kg dw	3,400	U	3400
10/4/99	SED-CSC-S2-0.2FT	Benzo(g,h,i)perylene	ug/kg dw	2,800	U	2800
10/4/99	SED-CSC-S3-0.2FT	Benzo(g,h,i)perylene	ug/kg dw	1,400	J	653.8
10/4/99	SED-CSD-S1-0.2FT	Benzo(g,h,i)perylene	ug/kg dw	4,300	U	4300
10/4/99	SED-CSD-S2-0.2FT	Benzo(g,h,i)perylene	ug/kg dw	4,700	U	4700
10/4/99	SED-CSD-S3-0.2FT	Benzo(g,h,i)perylene	ug/kg dw	660	J	500
10/6/99	SED-CSE-S1-0.2FT	Benzo(g,h,i)perylene	ug/kg dw	140	J	607
10/6/99	SED-CSE-S2-0.2FT	Benzo(g,h,i)perylene	ug/kg dw	170	J	447
10/6/99	SED-CSE-S3-0.2FT	Benzo(g,h,i)perylene	ug/kg dw	350	J	566.7
10/5/99	SED-M-S1-0.2FT	Benzo(g,h,i)perylene	ug/kg dw	1,300	J	850
10/5/99	SED-CSB-S1-0.2FT	Benzo(k)fluoranthene	ug/kg dw	1,500	J	425
10/5/99	SED-CSB-S2-0.2FT	Benzo(k)fluoranthene	ug/kg dw	1,600	J	425
10/5/99	SED-CSB-S3-0.2FT	Benzo(k)fluoranthene	ug/kg dw	920	J	566.7
10/4/99	SED-CSC-S1-0.2FT	Benzo(k)fluoranthene	ug/kg dw	3,400	U	3,400
10/4/99	SED-CSC-S2-0.2FT	Benzo(k)fluoranthene	ug/kg dw	390	J	486
10/4/99	SED-CSC-S3-0.2FT	Benzo(k)fluoranthene	ug/kg dw	1,200	J	654
10/4/99	SED-CSD-S1-0.2FT	Benzo(k)fluoranthene	ug/kg dw	660	J	739
10/4/99	SED-CSD-S2-0.2FT	Benzo(k)fluoranthene	ug/kg dw	520	J	810
10/4/99	SED-CSD-S3-0.2FT	Benzo(k)fluoranthene	ug/kg dw	610	J	500
10/6/99	SED-CSE-S1-0.2FT	Benzo(k)fluoranthene	ug/kg dw	600	U	600
10/6/99	SED-CSE-S2-0.2FT	Benzo(k)fluoranthene	ug/kg dw	170	J	447
10/6/99	SED-CSE-S3-0.2FT	Benzo(k)fluoranthene	ug/kg dw	600		566.7
10/5/99	SED-M-S1-0.2FT	Benzo(k)fluoranthene	ug/kg dw	1,800	J	850
10/5/99	SED-CSB-S1-0.2FT	bis(2-Ethylhexyl)phthalate	ug/kg dw	3,000		425
10/5/99	SED-CSB-S2-0.2FT	bis(2-Ethylhexyl)phthalate	ug/kg dw	2,600	U	2,600
10/5/99	SED-CSB-S3-0.2FT	bis(2-Ethylhexyl)phthalate	ug/kg dw	3,300	U	3,300
10/4/99	SED-CSC-S1-0.2FT	bis(2-Ethylhexyl)phthalate	ug/kg dw	3,400	U	3,400
10/4/99	SED-CSC-S2-0.2FT	bis(2-Ethylhexyl)phthalate	ug/kg dw	2,800	U	2,800
10/4/99	SED-CSC-S3-0.2FT	bis(2-Ethylhexyl)phthalate	ug/kg dw	3,900	U	3,900
10/4/99	SED-CSD-S1-0.2FT	bis(2-Ethylhexyl)phthalate	ug/kg dw	4,300	U	4,300
10/4/99	SED-CSD-S2-0.2FT	bis(2-Ethylhexyl)phthalate	ug/kg dw	4,700	U	4,700
10/4/99	SED-CSD-S3-0.2FT	bis(2-Ethylhexyl)phthalate	ug/kg dw	1,200	J	500
10/6/99	SED-CSE-S1-0.2FT	bis(2-Ethylhexyl)phthalate	ug/kg dw	600	U	600
10/6/99	SED-CSE-S2-0.2FT	bis(2-Ethylhexyl)phthalate	ug/kg dw	260	J	447
10/6/99	SED-CSE-S3-0.2FT	bis(2-Ethylhexyl)phthalate	ug/kg dw	250	J	566.7
10/5/99	SED-M-S1-0.2FT	bis(2-Ethylhexyl)phthalate	ug/kg dw	1,400	J	850
10/5/99	SED-CSB-S1-0.2FT	Chrysene	ug/kg dw	1,600	J	425
10/5/99	SED-CSB-S2-0.2FT	Chrysene	ug/kg dw	1,800	J	425
10/5/99	SED-CSB-S3-0.2FT	Chrysene	ug/kg dw	1,100	J	566.7
10/4/99	SED-CSC-S1-0.2FT	Chrysene	ug/kg dw	640	J	586
10/4/99	SED-CSC-S2-0.2FT	Chrysene	ug/kg dw	500	J	486
10/4/99	SED-CSC-S3-0.2FT	Chrysene	ug/kg dw	1,500	J	653.8
10/4/99	SED-CSD-S1-0.2FT	Chrysene	ug/kg dw	790	J	739
10/4/99	SED-CSD-S2-0.2FT	Chrysene	ug/kg dw	670	J	810
10/4/99	SED-CSD-S3-0.2FT	Chrysene	ug/kg dw	740	J	500
10/6/99	SED-CSE-S1-0.2FT	Chrysene	ug/kg dw	190	J	607
10/6/99	SED-CSE-S2-0.2FT	Chrysene	ug/kg dw	220	J	447
10/6/99	SED-CSE-S3-0.2FT	Chrysene	ug/kg dw	660		566.7
10/5/99	SED-M-S1-0.2FT	Chrysene	ug/kg dw	1,600	J	850
10/5/99	SED-CSB-S1-0.2FT	Fluoranthene	ug/kg dw	2,300	J	425

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/5/99	SED-CSB-S2-0.2FT	Fluoranthene	ug/kg dw	1,800	J	425
10/5/99	SED-CSB-S3-0.2FT	Fluoranthene	ug/kg dw	1,900	J	566.7
10/4/99	SED-CSC-S1-0.2FT	Fluoranthene	ug/kg dw	780	J	586
10/4/99	SED-CSC-S2-0.2FT	Fluoranthene	ug/kg dw	800	J	486
10/4/99	SED-CSC-S3-0.2FT	Fluoranthene	ug/kg dw	2,200	J	654
10/4/99	SED-CSD-S1-0.2FT	Fluoranthene	ug/kg dw	1,200	J	739
10/4/99	SED-CSD-S2-0.2FT	Fluoranthene	ug/kg dw	1,000	J	810
10/4/99	SED-CSD-S3-0.2FT	Fluoranthene	ug/kg dw	1,200	J	500
10/6/99	SED-CSE-S1-0.2FT	Fluoranthene	ug/kg dw	320	J	607
10/6/99	SED-CSE-S2-0.2FT	Fluoranthene	ug/kg dw	390	J	447
10/6/99	SED-CSE-S3-0.2FT	Fluoranthene	ug/kg dw	1,200		566.7
10/5/99	SED-M-S1-0.2FT	Fluoranthene	ug/kg dw	3,000	J	850
10/5/99	SED-CSB-S1-0.2FT	Indeno(1,2,3-cd)pyrene	ug/kg dw	1,300	J	425
10/5/99	SED-CSB-S2-0.2FT	Indeno(1,2,3-cd)pyrene	ug/kg dw	1,000	J	425
10/5/99	SED-CSB-S3-0.2FT	Indeno(1,2,3-cd)pyrene	ug/kg dw	3,300	U	3,300
10/4/99	SED-CSC-S1-0.2FT	Indeno(1,2,3-cd)pyrene	ug/kg dw	3,400	U	3,400
10/4/99	SED-CSC-S2-0.2FT	Indeno(1,2,3-cd)pyrene	ug/kg dw	2,800	U	2,800
10/4/99	SED-CSC-S3-0.2FT	Indeno(1,2,3-cd)pyrene	ug/kg dw	3,900	U	3,900
10/4/99	SED-CSD-S1-0.2FT	Indeno(1,2,3-cd)pyrene	ug/kg dw	4,300	U	4,300
10/4/99	SED-CSD-S2-0.2FT	Indeno(1,2,3-cd)pyrene	ug/kg dw	4,700	U	4,700
10/4/99	SED-CSD-S3-0.2FT	Indeno(1,2,3-cd)pyrene	ug/kg dw	2,900	U	2,900
10/6/99	SED-CSE-S1-0.2FT	Indeno(1,2,3-cd)pyrene	ug/kg dw	130	J	607
10/6/99	SED-CSE-S2-0.2FT	Indeno(1,2,3-cd)pyrene	ug/kg dw	150	J	447
10/6/99	SED-CSE-S3-0.2FT	Indeno(1,2,3-cd)pyrene	ug/kg dw	430	J	566.7
10/5/99	SED-M-S1-0.2FT	Indeno(1,2,3-cd)pyrene	ug/kg dw	5,000	U	5,000
10/5/99	SED-CSB-S1-0.2FT	Naphthalene	ug/kg dw	2,600	U	2,600
10/5/99	SED-CSB-S2-0.2FT	Naphthalene	ug/kg dw	380	J	425
10/5/99	SED-CSB-S3-0.2FT	Naphthalene	ug/kg dw	3,300	U	3,300
10/4/99	SED-CSC-S1-0.2FT	Naphthalene	ug/kg dw	3,400	U	3,400
10/4/99	SED-CSC-S2-0.2FT	Naphthalene	ug/kg dw	2,800	U	2,800
10/4/99	SED-CSC-S3-0.2FT	Naphthalene	ug/kg dw	3,900	U	3,900
10/4/99	SED-CSD-S1-0.2FT	Naphthalene	ug/kg dw	4,300	U	4,300
10/4/99	SED-CSD-S2-0.2FT	Naphthalene	ug/kg dw	4,700	U	4,700
10/4/99	SED-CSD-S3-0.2FT	Naphthalene	ug/kg dw	2,900	U	2,900
10/6/99	SED-CSE-S1-0.2FT	Naphthalene	ug/kg dw	600	U	600
10/6/99	SED-CSE-S2-0.2FT	Naphthalene	ug/kg dw	440	U	440
10/6/99	SED-CSE-S3-0.2FT	Naphthalene	ug/kg dw	560	U	560
10/5/99	SED-M-S1-0.2FT	Naphthalene	ug/kg dw	1,100	J	850
10/5/99	SED-CSB-S1-0.2FT	Phenanthrene	ug/kg dw	2,600	U	2600
10/5/99	SED-CSB-S2-0.2FT	Phenanthrene	ug/kg dw	930	J	425
10/5/99	SED-CSB-S3-0.2FT	Phenanthrene	ug/kg dw	910	J	566.7
10/4/99	SED-CSC-S1-0.2FT	Phenanthrene	ug/kg dw	530	J	586
10/4/99	SED-CSC-S2-0.2FT	Phenanthrene	ug/kg dw	320	J	486
10/4/99	SED-CSC-S3-0.2FT	Phenanthrene	ug/kg dw	840	J	654
10/4/99	SED-CSD-S1-0.2FT	Phenanthrene	ug/kg dw	4,300	U	4,300
10/4/99	SED-CSD-S2-0.2FT	Phenanthrene	ug/kg dw	4,700	U	4,700
10/4/99	SED-CSD-S3-0.2FT	Phenanthrene	ug/kg dw	410	J	500
10/6/99	SED-CSE-S1-0.2FT	Phenanthrene	ug/kg dw	130	J	607
10/6/99	SED-CSE-S2-0.2FT	Phenanthrene	ug/kg dw	120	J	447
10/6/99	SED-CSE-S3-0.2FT	Phenanthrene	ug/kg dw	510	J	566.7
10/5/99	SED-M-S1-0.2FT	Phenanthrene	ug/kg dw	1,300	J	850
10/5/99	SED-CSB-S1-0.2FT	Pyrene	ug/kg dw	3,000		425
10/5/99	SED-CSB-S2-0.2FT	Pyrene	ug/kg dw	2,200	J	425
10/5/99	SED-CSB-S3-0.2FT	Pyrene	ug/kg dw	2,000	J	566.7
10/4/99	SED-CSC-S1-0.2FT	Pyrene	ug/kg dw	940	J	586
10/4/99	SED-CSC-S2-0.2FT	Pyrene	ug/kg dw	660	J	486
10/4/99	SED-CSC-S3-0.2FT	Pyrene	ug/kg dw	2,000	J	654

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/4/99	SED-CSD-S1-0.2FT	Pyrene	ug/kg dw	950	J	739
10/4/99	SED-CSD-S2-0.2FT	Pyrene	ug/kg dw	970	J	810
10/4/99	SED-CSD-S3-0.2FT	Pyrene	ug/kg dw	1,100	J	500
10/6/99	SED-CSE-S1-0.2FT	Pyrene	ug/kg dw	250	J	807
10/6/99	SED-CSE-S2-0.2FT	Pyrene	ug/kg dw	310	J	447
10/6/99	SED-CSE-S3-0.2FT	Pyrene	ug/kg dw	1,000		566.7
10/5/99	SED-M-S1-0.2FT	Pyrene	ug/kg dw	2,200	J	850
PCBs ¹						
10/5/99	SED-CSB-S1-0.2FT	PCBs (Total)	ug/kg dw	162,180		
10/5/99	SED-CSB-S2-0.2FT	PCBs (Total)	ug/kg dw	226,140		
10/5/99	SED-CSB-S3-0.2FT	PCBs (Total)	ug/kg dw	67,700		
10/4/99	SED-CSC-S1-0.2FT	PCBs (Total)	ug/kg dw	160		
10/4/99	SED-CSC-S2-0.2FT	PCBs (Total)	ug/kg dw	2,920		
10/4/99	SED-CSC-S3-0.2FT	PCBs (Total)	ug/kg dw	4,600		
10/4/99	SED-CSD-S1-0.2FT	PCBs (Total)	ug/kg dw	697		
10/4/99	SED-CSD-S2-0.2FT	PCBs (Total)	ug/kg dw	1,150		
10/4/99	SED-CSD-S3-0.2FT	PCBs (Total)	ug/kg dw	730		
10/6/99	SED-CSE-S1-0.2FT	PCBs (Total)	ug/kg dw	1,038		
10/6/99	SED-CSE-S2-0.2FT	PCBs (Total)	ug/kg dw	ND	U	
10/6/99	SED-CSE-S3-0.2FT	PCBs (Total)	ug/kg dw	ND	U	
10/5/99	SED-M-S1-0.2FT	PCBs (Total)	ug/kg dw	12,200		
Pesticides						
10/5/99	SED-CSB-S1-0.2FT	4,4'-DDD	ug/kg dw	170	J	165
10/5/99	SED-CSB-S2-0.2FT	4,4'-DDD	ug/kg dw	970	U	970
10/5/99	SED-CSB-S3-0.2FT	4,4'-DDD	ug/kg dw	650	U	650
10/4/99	SED-CSC-S1-0.2FT	4,4'-DDD	ug/kg dw	28	J	23
10/4/99	SED-CSC-S2-0.2FT	4,4'-DDD	ug/kg dw	270	U	270
10/4/99	SED-CSC-S3-0.2FT	4,4'-DDD	ug/kg dw	380	U	380
10/4/99	SED-CSD-S1-0.2FT	4,4'-DDD	ug/kg dw	86	U	86
10/4/99	SED-CSD-S2-0.2FT	4,4'-DDD	ug/kg dw	94	U	94
10/4/99	SED-CSD-S3-0.2FT	4,4'-DDD	ug/kg dw	58	U	58
10/6/99	SED-CSE-S1-0.2FT	4,4'-DDD	ug/kg dw	120	U	120
10/6/99	SED-CSE-S2-0.2FT	4,4'-DDD	ug/kg dw	86	U	86
10/6/99	SED-CSE-S3-0.2FT	4,4'-DDD	ug/kg dw	22	U	22
10/5/99	SED-M-S1-0.2FT	4,4'-DDD	ug/kg dw	770	U	770
10/5/99	SED-CSB-S1-0.2FT	4,4'-DDE	ug/kg dw	970	U	970
10/5/99	SED-CSB-S2-0.2FT	4,4'-DDE	ug/kg dw	970	U	970
10/5/99	SED-CSB-S3-0.2FT	4,4'-DDE	ug/kg dw	650	U	650
10/4/99	SED-CSC-S1-0.2FT	4,4'-DDE	ug/kg dw	51	J	23
10/4/99	SED-CSC-S2-0.2FT	4,4'-DDE	ug/kg dw	270	U	270
10/4/99	SED-CSC-S3-0.2FT	4,4'-DDE	ug/kg dw	380	U	380
10/4/99	SED-CSD-S1-0.2FT	4,4'-DDE	ug/kg dw	20	J	14
10/4/99	SED-CSD-S2-0.2FT	4,4'-DDE	ug/kg dw	14	J	16
10/4/99	SED-CSD-S3-0.2FT	4,4'-DDE	ug/kg dw	4.4	J	9.7
10/6/99	SED-CSE-S1-0.2FT	4,4'-DDE	ug/kg dw	15	J	118
10/6/99	SED-CSE-S2-0.2FT	4,4'-DDE	ug/kg dw	3.4	J	87
10/6/99	SED-CSE-S3-0.2FT	4,4'-DDE	ug/kg dw	4.3	J	22
10/5/99	SED-M-S1-0.2FT	4,4'-DDE	ug/kg dw	110	J	82.5
10/5/99	SED-CSB-S1-0.2FT	4,4'-DDT	ug/kg dw	970	U	970
10/5/99	SED-CSB-S2-0.2FT	4,4'-DDT	ug/kg dw	970	U	970
10/5/99	SED-CSB-S3-0.2FT	4,4'-DDT	ug/kg dw	650	U	650
10/4/99	SED-CSC-S1-0.2FT	4,4'-DDT	ug/kg dw	140	U	140
10/4/99	SED-CSC-S2-0.2FT	4,4'-DDT	ug/kg dw	270	U	270
10/4/99	SED-CSC-S3-0.2FT	4,4'-DDT	ug/kg dw	380	U	380
10/4/99	SED-CSD-S1-0.2FT	4,4'-DDT	ug/kg dw	86	U	86
10/4/99	SED-CSD-S2-0.2FT	4,4'-DDT	ug/kg dw	94	U	94

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/4/99	SED-CSD-S3-0.2FT	4,4'-DDT	ug/kg dw	58	U	58
10/6/99	SED-CSE-S1-0.2FT	4,4'-DDT	ug/kg dw	9.3	J	118
10/6/99	SED-CSE-S2-0.2FT	4,4'-DDT	ug/kg dw	86	U	86
10/6/99	SED-CSE-S3-0.2FT	4,4'-DDT	ug/kg dw	22	U	22
10/5/99	SED-M-S1-0.2FT	4,4'-DDT	ug/kg dw	44	J	82.5
10/5/99	SED-CSB-S1-0.2FT	Aldrin	ug/kg dw	1,200	P	85
10/5/99	SED-CSB-S2-0.2FT	Aldrin	ug/kg dw	980	P	85
10/5/99	SED-CSB-S3-0.2FT	Aldrin	ug/kg dw	410		56.7
10/4/99	SED-CSC-S1-0.2FT	Aldrin	ug/kg dw	25	J	12
10/4/99	SED-CSC-S2-0.2FT	Aldrin	ug/kg dw	42	J	24
10/4/99	SED-CSC-S3-0.2FT	Aldrin	ug/kg dw	64	J	33
10/4/99	SED-CSD-S1-0.2FT	Aldrin	ug/kg dw	9.6	J	7.4
10/4/99	SED-CSD-S2-0.2FT	Aldrin	ug/kg dw	11	J	8.1
10/4/99	SED-CSD-S3-0.2FT	Aldrin	ug/kg dw	2.7	J	5
10/6/99	SED-CSE-S1-0.2FT	Aldrin	ug/kg dw	60	U	60
10/6/99	SED-CSE-S2-0.2FT	Aldrin	ug/kg dw	44	U	44
10/6/99	SED-CSE-S3-0.2FT	Aldrin	ug/kg dw	11	U	11
10/5/99	SED-M-S1-0.2FT	Aldrin	ug/kg dw	120	J	42.5
10/5/99	SED-CSB-S1-0.2FT	Alpha Chlordane	ug/kg dw	500	U	500
10/5/99	SED-CSB-S2-0.2FT	Alpha Chlordane	ug/kg dw	500	U	500
10/5/99	SED-CSB-S3-0.2FT	Alpha Chlordane	ug/kg dw	330	U	330
10/4/99	SED-CSC-S1-0.2FT	Alpha Chlordane	ug/kg dw	37	J	12
10/4/99	SED-CSC-S2-0.2FT	Alpha Chlordane	ug/kg dw	54	J	24
10/4/99	SED-CSC-S3-0.2FT	Alpha Chlordane	ug/kg dw	120	J	33
10/4/99	SED-CSD-S1-0.2FT	Alpha Chlordane	ug/kg dw	26	J	7.4
10/4/99	SED-CSD-S2-0.2FT	Alpha Chlordane	ug/kg dw	14	J	8.1
10/4/99	SED-CSD-S3-0.2FT	Alpha Chlordane	ug/kg dw	30	U	30
10/6/99	SED-CSE-S1-0.2FT	Alpha Chlordane	ug/kg dw	6.9	J	61
10/6/99	SED-CSE-S2-0.2FT	Alpha Chlordane	ug/kg dw	2.5	J	45
10/6/99	SED-CSE-S3-0.2FT	Alpha Chlordane	ug/kg dw	3.9	J	11.3
10/5/99	SED-M-S1-0.2FT	Alpha Chlordane	ug/kg dw	400	U	400
10/5/99	SED-CSB-S1-0.2FT	delta-BHC	ug/kg dw	150	U	150
10/5/99	SED-CSB-S2-0.2FT	delta-BHC	ug/kg dw	150	U	150
10/5/99	SED-CSB-S3-0.2FT	delta-BHC	ug/kg dw	98	U	98
10/4/99	SED-CSC-S1-0.2FT	delta-BHC	ug/kg dw	21	U	21
10/4/99	SED-CSC-S2-0.2FT	delta-BHC	ug/kg dw	41	U	41
10/4/99	SED-CSC-S3-0.2FT	delta-BHC	ug/kg dw	18	J	9.6
10/4/99	SED-CSD-S1-0.2FT	delta-BHC	ug/kg dw	16		2.2
10/4/99	SED-CSD-S2-0.2FT	delta-BHC	ug/kg dw	14	U	14
10/4/99	SED-CSD-S3-0.2FT	delta-BHC	ug/kg dw	1.5	J	1.5
10/6/99	SED-CSE-S1-0.2FT	delta-BHC	ug/kg dw	1.3	J	18
10/6/99	SED-CSE-S2-0.2FT	delta-BHC	ug/kg dw	13	U	13
10/6/99	SED-CSE-S3-0.2FT	delta-BHC	ug/kg dw	3.3	U	3.3
10/5/99	SED-M-S1-0.2FT	delta-BHC	ug/kg dw	120	U	120
10/5/99	SED-CSB-S1-0.2FT	Dieldrin	ug/kg dw	970	U	970
10/5/99	SED-CSB-S2-0.2FT	Dieldrin	ug/kg dw	970	U	970
10/5/99	SED-CSB-S3-0.2FT	Dieldrin	ug/kg dw	650	U	650
10/4/99	SED-CSC-S1-0.2FT	Dieldrin	ug/kg dw	140	U	140
10/4/99	SED-CSC-S2-0.2FT	Dieldrin	ug/kg dw	270	U	270
10/4/99	SED-CSC-S3-0.2FT	Dieldrin	ug/kg dw	380	U	380
10/4/99	SED-CSD-S1-0.2FT	Dieldrin	ug/kg dw	86	U	86
10/4/99	SED-CSD-S2-0.2FT	Dieldrin	ug/kg dw	94	U	94
10/4/99	SED-CSD-S3-0.2FT	Dieldrin	ug/kg dw	58	U	58
10/6/99	SED-CSE-S1-0.2FT	Dieldrin	ug/kg dw	9.4	J	118
10/6/99	SED-CSE-S2-0.2FT	Dieldrin	ug/kg dw	1.7	J	87
10/6/99	SED-CSE-S3-0.2FT	Dieldrin	ug/kg dw	5.4	J	22
10/5/99	SED-M-S1-0.2FT	Dieldrin	ug/kg dw	770	U	770

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/5/99	SED-CSB-S1-0.2FT	Endosulfan II	ug/kg dw	970	U	970
10/5/99	SED-CSB-S2-0.2FT	Endosulfan II	ug/kg dw	970	U	970
10/5/99	SED-CSB-S3-0.2FT	Endosulfan II	ug/kg dw	650	U	650
10/4/99	SED-CSC-S1-0.2FT	Endosulfan II	ug/kg dw	140	U	140
10/4/99	SED-CSC-S2-0.2FT	Endosulfan II	ug/kg dw	270	U	270
10/4/99	SED-CSC-S3-0.2FT	Endosulfan II	ug/kg dw	380	U	380
10/4/99	SED-CSD-S1-0.2FT	Endosulfan II	ug/kg dw	86	U	86
10/4/99	SED-CSD-S2-0.2FT	Endosulfan II	ug/kg dw	94	U	94
10/4/99	SED-CSD-S3-0.2FT	Endosulfan II	ug/kg dw	58	U	58
10/6/99	SED-CSE-S1-0.2FT	Endosulfan II	ug/kg dw	12	J	118
10/6/99	SED-CSE-S2-0.2FT	Endosulfan II	ug/kg dw	2.3	J	87
10/6/99	SED-CSE-S3-0.2FT	Endosulfan II	ug/kg dw	22	U	22
10/5/99	SED-M-S1-0.2FT	Endosulfan II	ug/kg dw	770	U	770
10/5/99	SED-CSB-S1-0.2FT	Endosulfan sulfate	ug/kg dw	970	U	970
10/5/99	SED-CSB-S2-0.2FT	Endosulfan sulfate	ug/kg dw	130	J	165
10/5/99	SED-CSB-S3-0.2FT	Endosulfan sulfate	ug/kg dw	98	J	110
10/4/99	SED-CSC-S1-0.2FT	Endosulfan sulfate	ug/kg dw	9	J	23
10/4/99	SED-CSC-S2-0.2FT	Endosulfan sulfate	ug/kg dw	16	J	47
10/4/99	SED-CSC-S3-0.2FT	Endosulfan sulfate	ug/kg dw	380	U	380
10/4/99	SED-CSD-S1-0.2FT	Endosulfan sulfate	ug/kg dw	86	U	86
10/4/99	SED-CSD-S2-0.2FT	Endosulfan sulfate	ug/kg dw	94	U	94
10/4/99	SED-CSD-S3-0.2FT	Endosulfan sulfate	ug/kg dw	58	U	58
10/6/99	SED-CSE-S1-0.2FT	Endosulfan sulfate	ug/kg dw	10	J	118
10/6/99	SED-CSE-S2-0.2FT	Endosulfan sulfate	ug/kg dw	86	U	86
10/6/99	SED-CSE-S3-0.2FT	Endosulfan sulfate	ug/kg dw	22	U	22
10/5/99	SED-M-S1-0.2FT	Endosulfan sulfate	ug/kg dw	50	J	82.5
10/5/99	SED-CSB-S1-0.2FT	Endrin	ug/kg dw	970	U	970
10/5/99	SED-CSB-S2-0.2FT	Endrin	ug/kg dw	970	U	970
10/5/99	SED-CSB-S3-0.2FT	Endrin	ug/kg dw	650	U	650
10/4/99	SED-CSC-S1-0.2FT	Endrin	ug/kg dw	140	U	140
10/4/99	SED-CSC-S2-0.2FT	Endrin	ug/kg dw	270	U	270
10/4/99	SED-CSC-S3-0.2FT	Endrin	ug/kg dw	380	U	380
10/4/99	SED-CSD-S1-0.2FT	Endrin	ug/kg dw	86	U	86
10/4/99	SED-CSD-S2-0.2FT	Endrin	ug/kg dw	94	U	94
10/4/99	SED-CSD-S3-0.2FT	Endrin	ug/kg dw	58	U	58
10/6/99	SED-CSE-S1-0.2FT	Endrin	ug/kg dw	4.6	J	118
10/6/99	SED-CSE-S2-0.2FT	Endrin	ug/kg dw	86	U	86
10/6/99	SED-CSE-S3-0.2FT	Endrin	ug/kg dw	22	U	22
10/5/99	SED-M-S1-0.2FT	Endrin	ug/kg dw	770	U	770
10/5/99	SED-CSB-S1-0.2FT	Endrin aldehyde	ug/kg dw	520	J	165
10/5/99	SED-CSB-S2-0.2FT	Endrin aldehyde	ug/kg dw	970	U	970
10/5/99	SED-CSB-S3-0.2FT	Endrin aldehyde	ug/kg dw	650	U	650
10/4/99	SED-CSC-S1-0.2FT	Endrin aldehyde	ug/kg dw	140	U	140
10/4/99	SED-CSC-S2-0.2FT	Endrin aldehyde	ug/kg dw	270	U	270
10/4/99	SED-CSC-S3-0.2FT	Endrin aldehyde	ug/kg dw	380	U	380
10/4/99	SED-CSD-S1-0.2FT	Endrin aldehyde	ug/kg dw	86	U	86
10/4/99	SED-CSD-S2-0.2FT	Endrin aldehyde	ug/kg dw	94	U	94
10/4/99	SED-CSD-S3-0.2FT	Endrin aldehyde	ug/kg dw	16	J	9.7
10/6/99	SED-CSE-S1-0.2FT	Endrin aldehyde	ug/kg dw	22	J	118
10/6/99	SED-CSE-S2-0.2FT	Endrin aldehyde	ug/kg dw	3.6	J	87
10/6/99	SED-CSE-S3-0.2FT	Endrin aldehyde	ug/kg dw	22	U	22
10/5/99	SED-M-S1-0.2FT	Endrin aldehyde	ug/kg dw	770	U	770
10/5/99	SED-CSB-S1-0.2FT	Endrin ketone	ug/kg dw	970	U	970
10/5/99	SED-CSB-S2-0.2FT	Endrin ketone	ug/kg dw	970	U	970
10/5/99	SED-CSB-S3-0.2FT	Endrin ketone	ug/kg dw	650	U	650
10/4/99	SED-CSC-S1-0.2FT	Endrin ketone	ug/kg dw	140	U	140
10/4/99	SED-CSC-S2-0.2FT	Endrin ketone	ug/kg dw	270	U	270

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/4/99	SED-CSC-S3-0.2FT	Endrin ketone	ug/kg dw	380	U	380
10/4/99	SED-CSD-S1-0.2FT	Endrin ketone	ug/kg dw	86	U	86
10/4/99	SED-CSD-S2-0.2FT	Endrin ketone	ug/kg dw	94	U	94
10/4/99	SED-CSD-S3-0.2FT	Endrin ketone	ug/kg dw	5.5	J	9.7
10/6/99	SED-CSE-S1-0.2FT	Endrin ketone	ug/kg dw	17	J	118
10/6/99	SED-CSE-S2-0.2FT	Endrin ketone	ug/kg dw	6.8	J	87
10/6/99	SED-CSE-S3-0.2FT	Endrin ketone	ug/kg dw	22	U	22
10/5/99	SED-M-S1-0.2FT	Endrin ketone	ug/kg dw	200	J	82.5
10/5/99	SED-CSB-S1-0.2FT	Gamma Chlordane	ug/kg dw	760	P	85
10/5/99	SED-CSB-S2-0.2FT	Gamma Chlordane	ug/kg dw	500	U	500
10/5/99	SED-CSB-S3-0.2FT	Gamma Chlordane	ug/kg dw	330	U	330
10/4/99	SED-CSC-S1-0.2FT	Gamma Chlordane	ug/kg dw	110		12
10/4/99	SED-CSC-S2-0.2FT	Gamma Chlordane	ug/kg dw	140	P	24
10/4/99	SED-CSC-S3-0.2FT	Gamma Chlordane	ug/kg dw	250		33
10/4/99	SED-CSD-S1-0.2FT	Gamma Chlordane	ug/kg dw	49	P	7.4
10/4/99	SED-CSD-S2-0.2FT	Gamma Chlordane	ug/kg dw	29	J	8.1
10/4/99	SED-CSD-S3-0.2FT	Gamma Chlordane	ug/kg dw	6.7	J	5
10/6/99	SED-CSE-S1-0.2FT	Gamma Chlordane	ug/kg dw	14	J	61
10/6/99	SED-CSE-S2-0.2FT	Gamma Chlordane	ug/kg dw	5.9	J	45
10/6/99	SED-CSE-S3-0.2FT	Gamma Chlordane	ug/kg dw	5.1	J	11.3
10/5/99	SED-M-S1-0.2FT	Gamma Chlordane	ug/kg dw	140	J	42.5
10/5/99	SED-CSB-S1-0.2FT	Heptachlor	ug/kg dw	500	U	500
10/5/99	SED-CSB-S2-0.2FT	Heptachlor	ug/kg dw	500	P	85
10/5/99	SED-CSB-S3-0.2FT	Heptachlor	ug/kg dw	330	U	330
10/4/99	SED-CSC-S1-0.2FT	Heptachlor	ug/kg dw	70	U	70
10/4/99	SED-CSC-S2-0.2FT	Heptachlor	ug/kg dw	9.1	J	24
10/4/99	SED-CSC-S3-0.2FT	Heptachlor	ug/kg dw	9.7	J	33
10/4/99	SED-CSD-S1-0.2FT	Heptachlor	ug/kg dw	44	U	44
10/4/99	SED-CSD-S2-0.2FT	Heptachlor	ug/kg dw	48	U	48
10/4/99	SED-CSD-S3-0.2FT	Heptachlor	ug/kg dw	30	U	30
10/6/99	SED-CSE-S1-0.2FT	Heptachlor	ug/kg dw	60	U	60
10/6/99	SED-CSE-S2-0.2FT	Heptachlor	ug/kg dw	44	U	44
10/6/99	SED-CSE-S3-0.2FT	Heptachlor	ug/kg dw	0.53	U	11
10/5/99	SED-M-S1-0.2FT	Heptachlor	ug/kg dw	59	J	42.5
10/5/99	SED-CSB-S1-0.2FT	Heptachlor epoxide	ug/kg dw	500	U	500
10/5/99	SED-CSB-S2-0.2FT	Heptachlor epoxide	ug/kg dw	500	U	500
10/5/99	SED-CSB-S3-0.2FT	Heptachlor epoxide	ug/kg dw	330	U	330
10/4/99	SED-CSC-S1-0.2FT	Heptachlor epoxide	ug/kg dw	70	U	70
10/4/99	SED-CSC-S2-0.2FT	Heptachlor epoxide	ug/kg dw	140	U	140
10/4/99	SED-CSC-S3-0.2FT	Heptachlor epoxide	ug/kg dw	200	U	200
10/4/99	SED-CSD-S1-0.2FT	Heptachlor epoxide	ug/kg dw	44	U	44
10/4/99	SED-CSD-S2-0.2FT	Heptachlor epoxide	ug/kg dw	48	U	48
10/4/99	SED-CSD-S3-0.2FT	Heptachlor epoxide	ug/kg dw	30	U	30
10/6/99	SED-CSE-S1-0.2FT	Heptachlor epoxide	ug/kg dw	5.2	J	61
10/6/99	SED-CSE-S2-0.2FT	Heptachlor epoxide	ug/kg dw	44	U	44
10/6/99	SED-CSE-S3-0.2FT	Heptachlor epoxide	ug/kg dw	11	J	11.3
10/5/99	SED-M-S1-0.2FT	Heptachlor epoxide	ug/kg dw	400	U	400
10/5/99	SED-CSB-S1-0.2FT	Methoxychlor	ug/kg dw	5,000	U	5,000
10/5/99	SED-CSB-S2-0.2FT	Methoxychlor	ug/kg dw	5,000	U	5,000
10/5/99	SED-CSB-S3-0.2FT	Methoxychlor	ug/kg dw	3,300	U	3,300
10/4/99	SED-CSC-S1-0.2FT	Methoxychlor	ug/kg dw	700	U	700
10/4/99	SED-CSC-S2-0.2FT	Methoxychlor	ug/kg dw	1,400	U	1,400
10/4/99	SED-CSC-S3-0.2FT	Methoxychlor	ug/kg dw	2,000	U	2,000
10/4/99	SED-CSD-S1-0.2FT	Methoxychlor	ug/kg dw	440	U	440
10/4/99	SED-CSD-S2-0.2FT	Methoxychlor	ug/kg dw	480	U	480
10/4/99	SED-CSD-S3-0.2FT	Methoxychlor	ug/kg dw	300	U	300
10/6/99	SED-CSE-S1-0.2FT	Methoxychlor	ug/kg dw	39	J	607

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
10/6/99	SED-CSE-S2-0.2FT	Methoxychlor	ug/kg dw	440	U	440
10/6/99	SED-CSE-S3-0.2FT	Methoxychlor	ug/kg dw	110	U	110
10/5/99	SED-M-S1-0.2FT	Methoxychlor	ug/kg dw	4,000	U	4,000
Herbicides						
10/5/99	SED-CSB-S1-0.2FT	2,4-D	ug/kg dw	110	U	110
10/5/99	SED-CSB-S2-0.2FT	2,4-D	ug/kg dw	21	U	21
10/5/99	SED-CSB-S3-0.2FT	2,4-D	ug/kg dw	140	U	140
10/4/99	SED-CSC-S1-0.2FT	2,4-D	ug/kg dw	28	U	28
10/4/99	SED-CSC-S2-0.2FT	2,4-D	ug/kg dw	24	U	24
10/4/99	SED-CSC-S3-0.2FT	2,4-D	ug/kg dw	180	U	180
10/4/99	SED-CSD-S1-0.2FT	2,4-D	ug/kg dw	190	U	190
10/4/99	SED-CSD-S2-0.2FT	2,4-D	ug/kg dw	220	U	220
10/4/99	SED-CSD-S3-0.2FT	2,4-D	ug/kg dw	24	U	24
10/6/99	SED-CSE-S1-0.2FT	2,4-D	ug/kg dw	73	J	30
10/6/99	SED-CSE-S2-0.2FT	2,4-D	ug/kg dw	130	U	130
10/6/99	SED-CSE-S3-0.2FT	2,4-D	ug/kg dw	140	U	140
10/5/99	SED-M-S1-0.2FT	2,4-D	ug/kg dw	220	U	220
10/5/99	SED-CSB-S1-0.2FT	2,4-DB	ug/kg dw	110	U	110
10/5/99	SED-CSB-S2-0.2FT	2,4-DB	ug/kg dw	21	U	21
10/5/99	SED-CSB-S3-0.2FT	2,4-DB	ug/kg dw	140	U	140
10/4/99	SED-CSC-S1-0.2FT	2,4-DB	ug/kg dw	28	U	28
10/4/99	SED-CSC-S2-0.2FT	2,4-DB	ug/kg dw	24	U	24
10/4/99	SED-CSC-S3-0.2FT	2,4-DB	ug/kg dw	180	U	180
10/4/99	SED-CSD-S1-0.2FT	2,4-DB	ug/kg dw	190	U	190
10/4/99	SED-CSD-S2-0.2FT	2,4-DB	ug/kg dw	220	U	220
10/4/99	SED-CSD-S3-0.2FT	2,4-DB	ug/kg dw	24	U	24
10/6/99	SED-CSE-S1-0.2FT	2,4-DB	ug/kg dw	150		30
10/6/99	SED-CSE-S2-0.2FT	2,4-DB	ug/kg dw	130	U	130
10/6/99	SED-CSE-S3-0.2FT	2,4-DB	ug/kg dw	140	U	140
10/5/99	SED-M-S1-0.2FT	2,4-DB	ug/kg dw	220	U	220
10/5/99	SED-CSB-S1-0.2FT	Dicamba	ug/kg dw	260	U	260
10/5/99	SED-CSB-S2-0.2FT	Dicamba	ug/kg dw	50	U	50
10/5/99	SED-CSB-S3-0.2FT	Dicamba	ug/kg dw	350	U	350
10/4/99	SED-CSC-S1-0.2FT	Dicamba	ug/kg dw	68	U	68
10/4/99	SED-CSC-S2-0.2FT	Dicamba	ug/kg dw	57	U	57
10/4/99	SED-CSC-S3-0.2FT	Dicamba	ug/kg dw	440	U	440
10/4/99	SED-CSD-S1-0.2FT	Dicamba	ug/kg dw	460	U	460
10/4/99	SED-CSD-S2-0.2FT	Dicamba	ug/kg dw	13	J	95
10/4/99	SED-CSD-S3-0.2FT	Dicamba	ug/kg dw	59	U	59
10/6/99	SED-CSE-S1-0.2FT	Dicamba	ug/kg dw	410	U	410
10/6/99	SED-CSE-S2-0.2FT	Dicamba	ug/kg dw	300	U	300
10/6/99	SED-CSE-S3-0.2FT	Dicamba	ug/kg dw	340	U	340
10/5/99	SED-M-S1-0.2FT	Dicamba	ug/kg dw	540	U	540
10/5/99	SED-CSB-S1-0.2FT	Pentachlorophenol	ug/kg dw	57	J	42.5
10/5/99	SED-CSB-S2-0.2FT	Pentachlorophenol	ug/kg dw	220		42.5
10/5/99	SED-CSB-S3-0.2FT	Pentachlorophenol	ug/kg dw	56	J	56.7
10/4/99	SED-CSC-S1-0.2FT	Pentachlorophenol	ug/kg dw	7.4	J	59
10/4/99	SED-CSC-S2-0.2FT	Pentachlorophenol	ug/kg dw	23	J	49
10/4/99	SED-CSC-S3-0.2FT	Pentachlorophenol	ug/kg dw	23	J	65
10/4/99	SED-CSD-S1-0.2FT	Pentachlorophenol	ug/kg dw	400	U	400
10/4/99	SED-CSD-S2-0.2FT	Pentachlorophenol	ug/kg dw	450	U	450
10/4/99	SED-CSD-S3-0.2FT	Pentachlorophenol	ug/kg dw	3.9	J	50
10/6/99	SED-CSE-S1-0.2FT	Pentachlorophenol	ug/kg dw	350	U	350
10/6/99	SED-CSE-S2-0.2FT	Pentachlorophenol	ug/kg dw	12	J	45
10/6/99	SED-CSE-S3-0.2FT	Pentachlorophenol	ug/kg dw	3.8	J	56.7
10/5/99	SED-M-S1-0.2FT	Pentachlorophenol	ug/kg dw	52	J	85

Table 3
Constituents Detected in Sediment
Site Sampling Plan Results
Dead Creek - Sauget Area 1

Date	Sample Location	Parameter	Units	Result	Flag	PQL
------	-----------------	-----------	-------	--------	------	-----

Notes:

1) Individual -chlorobiphenyls analyzed; totals included in this table

PQL - practical quantitation limit

NA - no data

ND - not detected

Data Flag Explanations:

B - Estimated value

E - Estimated value

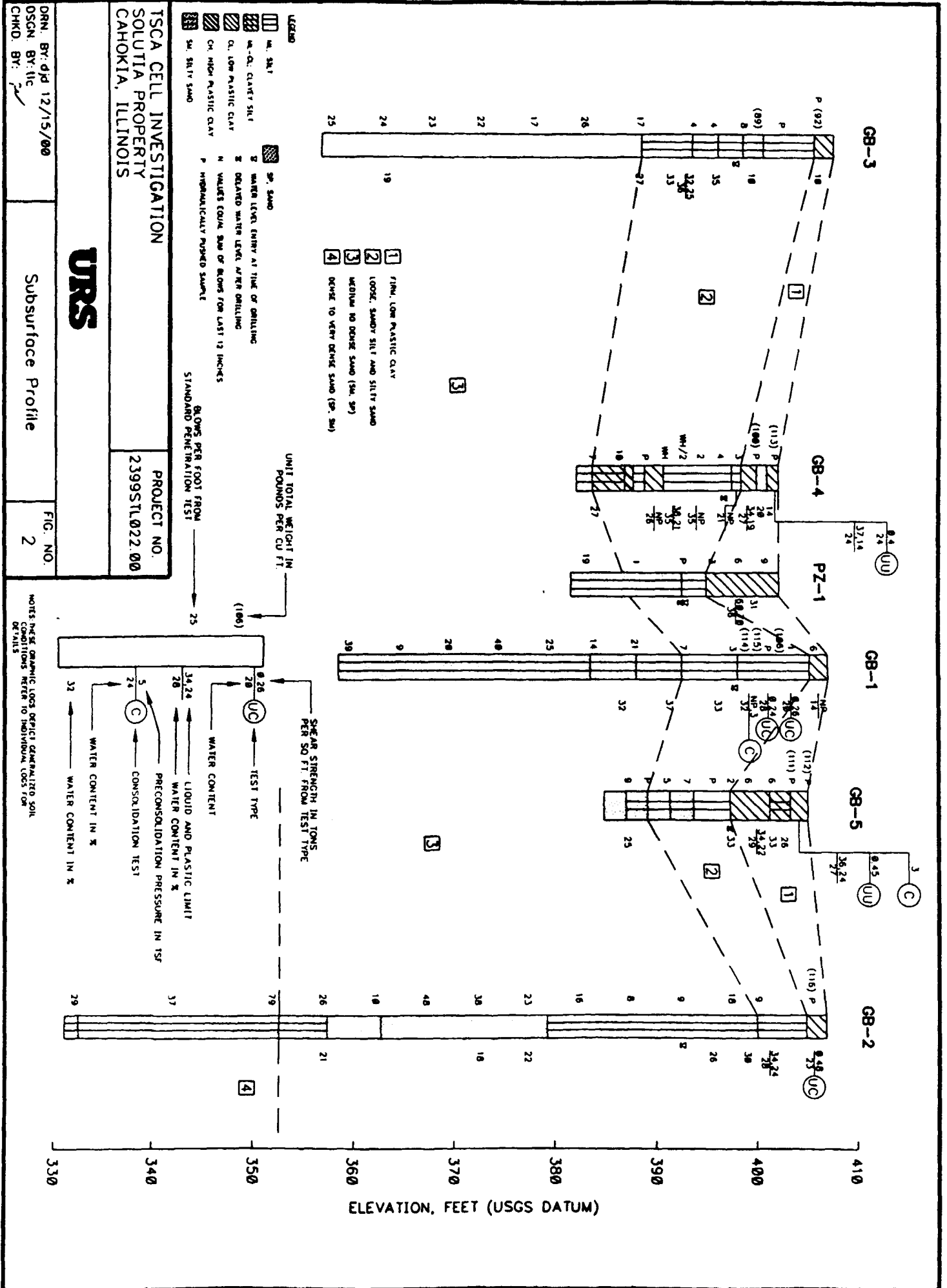
J - Estimated value

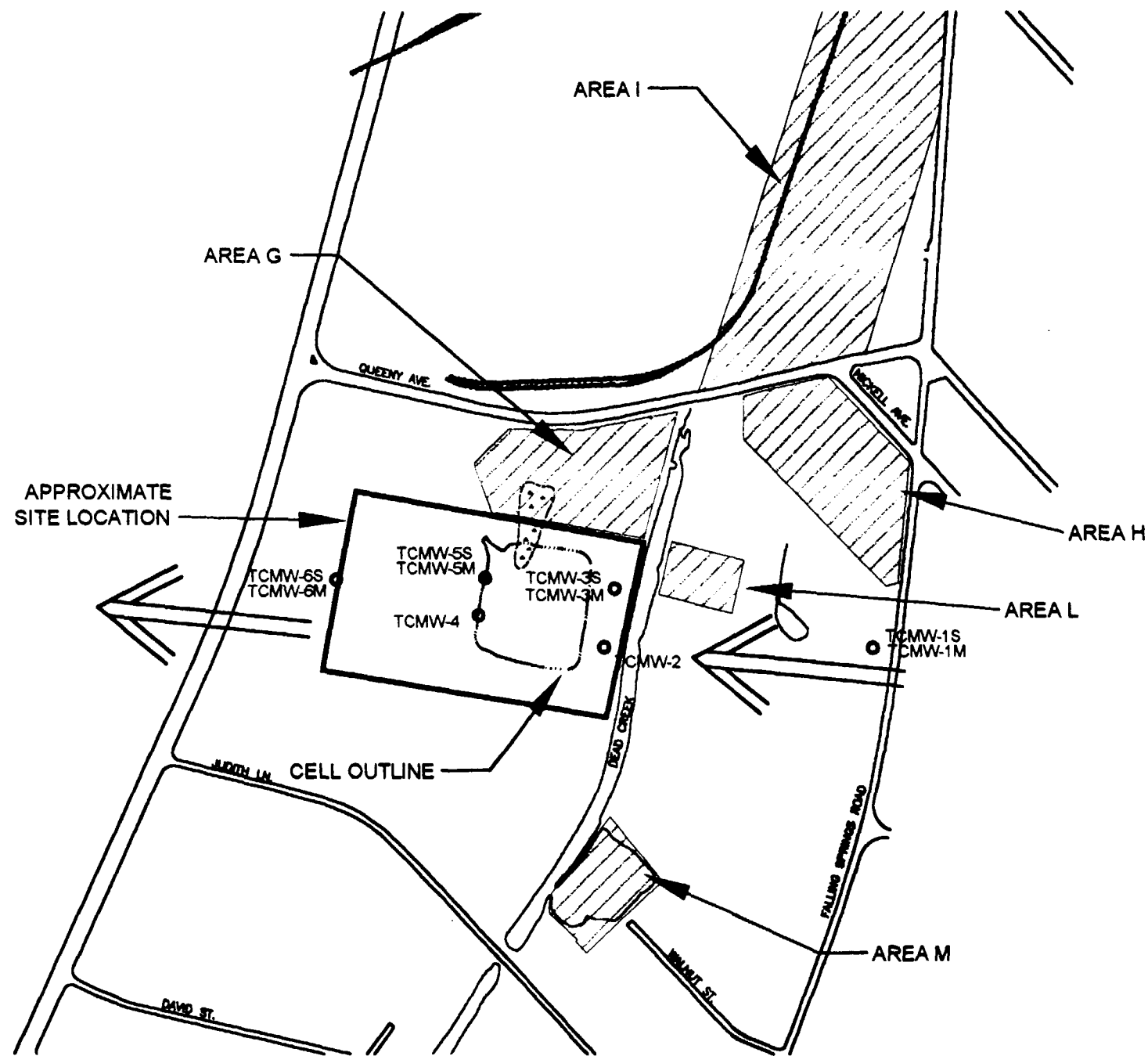
N - Spike recovery was not within control limits

P - Greater than 25% difference for detected concentration between the GC columns

U - Not detected

Drawings



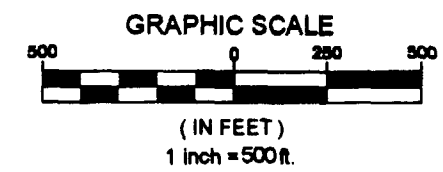


LEGEND

- TCMW-1S
● TCMW-1M

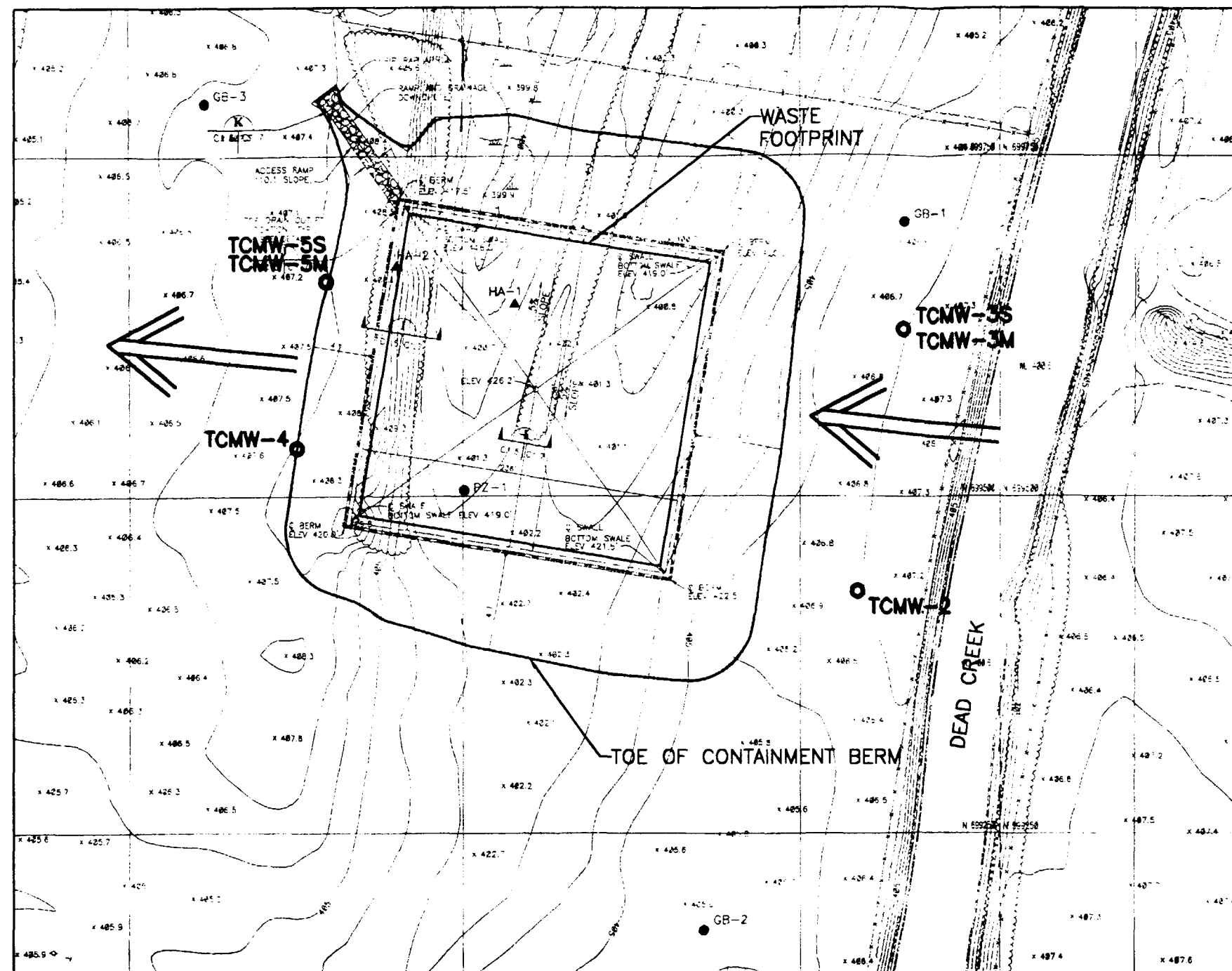
GROUNDWATER
MONITORING WELL
LOCATION
- ←

APPROXIMATE
GROUNDWATER
FLOW DIRECTION





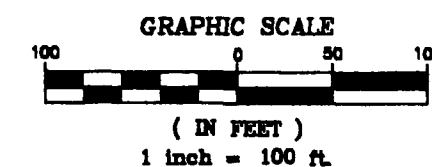
- NOTES:
1. THE BASE MAP WAS PROVIDED BY ROUX ASSOCIATES, INC.
 2. THE AREA LOCATIONS ARE ESTIMATED FROM "EXPANDED SITE INVESTIGATION, DEAD CREEK PROJECT SITES AT CAHOKIA/SUGET, ILLINOIS", ECOLOGY AND ENVIRONMENT, INC. MAY 1988.
 3. SITE LOCATION AND SIZE IS ESTIMATED FROM "SAUGET AREA 1 TSCA CONTAINMENT CELL DESIGN REPORT SOLUTIONA INC. CAHOKIA, ILLINOIS", URS, APRIL 2, 2001.

<p>Williams R. S. Williams & Associates Consulting Engineers</p>		<p>TITLE MONITORING WELL LOCATIONS</p>	
<p>CLIENT/PROJECT SOLUTIONA / TSCA CELL</p>		<p>DRAWN DW</p>	<p>DATE 7/17/01</p>
		<p>DESIGNED</p>	<p>SCALE AS SHOWN</p>
		<p>REVIEWED</p>	<p>FIGURE NO. 4</p>
		<p>FILE NAME Fig-04</p>	<p>FIGURE NO.</p>



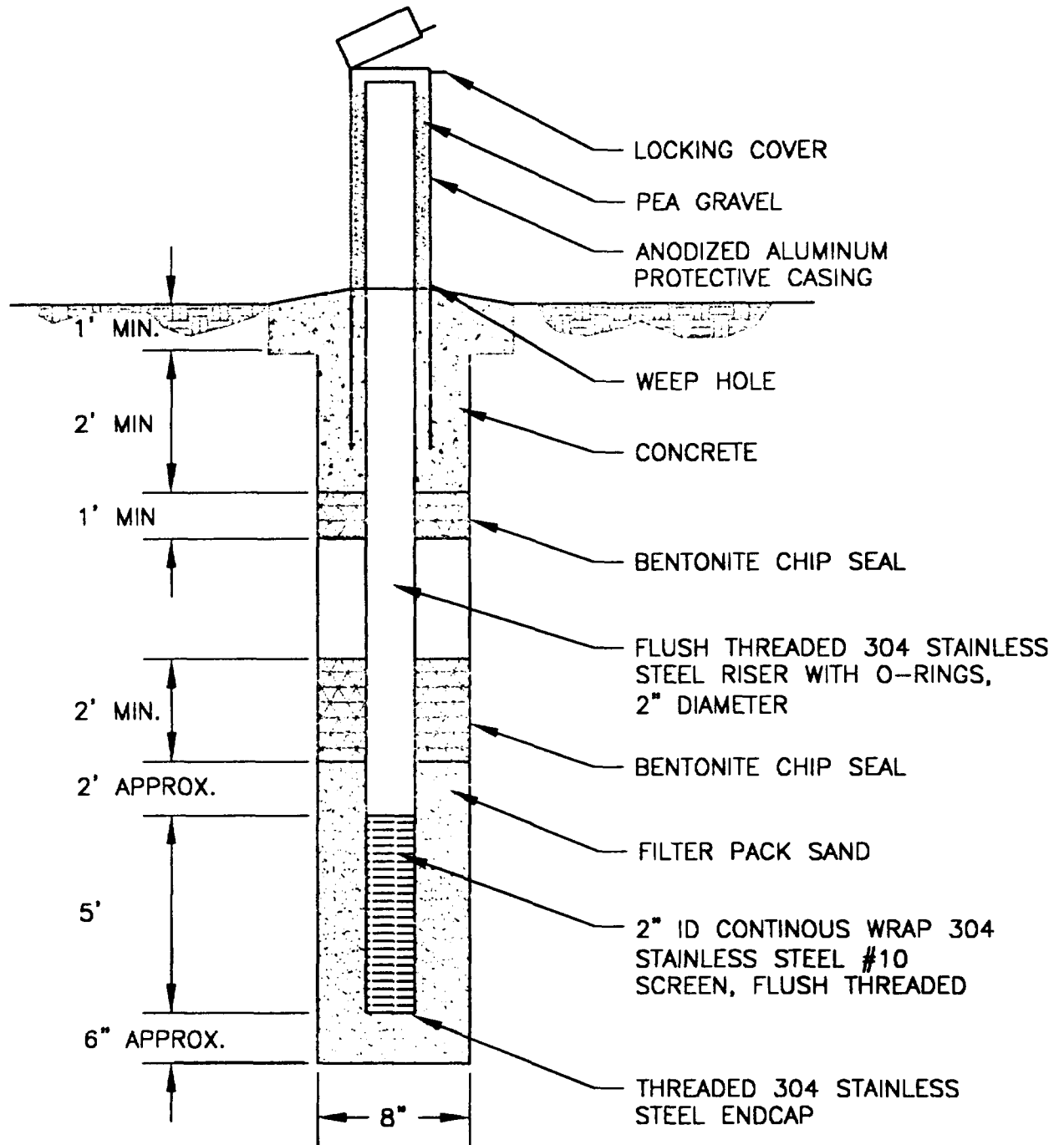
LEGEND

- 
TCMW-2 PROPOSED MONITORING WELL LOCATION
- 
 APPROXIMATE GROUNDWATER FLOW DIRECTION



NOTE:
THE BASE DRAWING IS ADAPTED FROM URS GREINER
WOODWARD CLYDE, TAMPA FLORIDA.

Williams R. S. Williams & Associates Consulting Engineers		TITLE GROUNDWATER MONITORING WELL NEAR CELL LOCATION PLAN	
CLIENT/PROJECT SOLUTIA / TSCA CELL		DRAWN DW	DATE 07/30/01
		CHECKED	SCALE AS SHOWN
		REVIEWED	FIG. NO. 5
		FILE NAME Fig-05	



Williams

R. S. Williams & Associates
Consulting Engineers

TITLE

GROUNDWATER
MONITORING WELL DETAIL

CLIENT/PROJECT

SOLUTION / TASCA CELL

DESIGN

DW

DATE

03/01/01

JOB NO.

CHECKED

SCALE

N.T.S.

DRAW. NO.

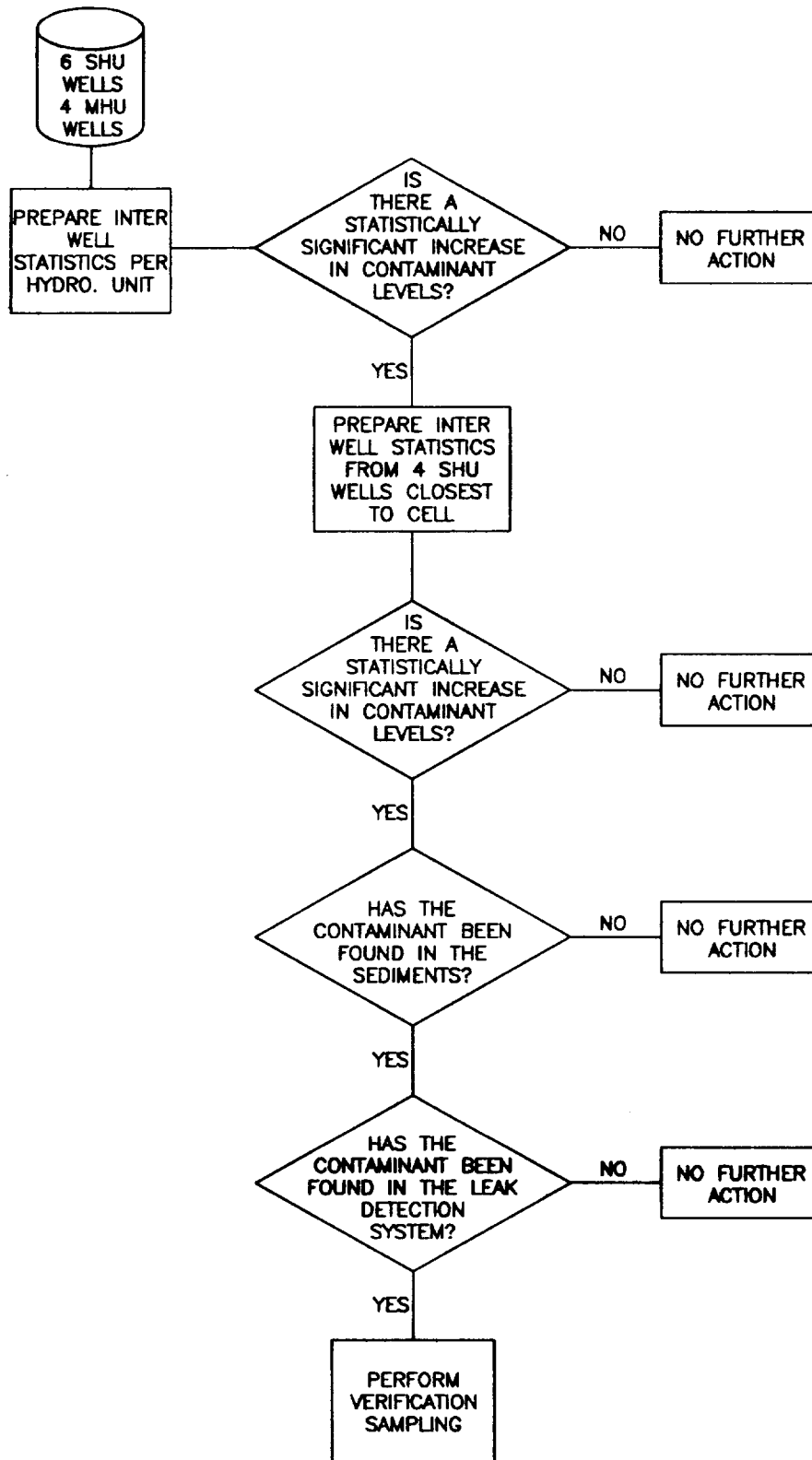
5

REVISION

FILE NAME

Fig-06

FIGURE NO.



Williams

R. S. Williams & Associates
Consulting Engineers

CLIENT/PROJECT

SOLUTIA/TSCA CELL

TITLE

FLOW CHART
DEPICTING SAMPLING DATA
EVALUATION ALGORITHM

DESIGNED DW

DATE 07/17/01

SHEET NO.

CHECKED

SCALE NTS

SHEET NO. 7

REVIEWED

FILE NAME Fig-07

WORKSHEET

Appendix A

BoringLogs

KEY TO BORING LOGS

Graphic Symbol	Description	USC Class.
GRAVEL	GRAVEL with little or no fines	GP or GW
	Silty GRAVEL	GM
	Clayey GRAVEL	GC
SAND	SAND with little or no fines	SP or SW
	Silty SAND	SM
	Clayey SAND	SC
LOW PLASTIC SILTS AND CLAYS	Inorganic low plastic SILT	ML
	Inorganic low plastic CLAY	CL
	Silty	CL
	Sandy	CL
	Gravelly	CL
	Organic low plastic SILT or CLAY	OL
HIGH PLASTIC SILTS AND CLAYS	Inorganic high plastic SILT	MH
	Inorganic high plastic CLAY	CH
	Organic high plastic SILT or CLAY	OH
	Peat and other highly organic soils	PT
ROCKS	LIMESTONE	
	SHALE	
	SANDSTONE	
	SILTSTONE	
SURFACE MATERIALS	Topsoil or pavement	
	FILL	

TERMS DESCRIBING CONSISTENCY OR CONDITION

Coarse grained soils (major portion retained on No. 200 sieve): Includes gravels and sands. Condition is rated according to the Standard Penetration Resistance, as shown below.

Descriptive Term	Blows per Foot
Very loose	0 - 5
Loose	5 - 10
Medium dense	10 - 30
Dense	30 - 50
Very dense	Greater than 50

Fine grained soils (major portion passing No. 200 sieve): Includes clays and silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

Descriptive Term	Unconfined Compressive Strength, tons/sq. ft.	Hand Test
Very soft	less than 0.25	Extrudes between fingers
Soft	0.25 - 0.50	Molded by slight pressure
Firm	0.50 - 1.00	Molded by strong pressure
Stiff	1.00 - 2.00	Indented by thumb
Very stiff	2.00 - 4.00	Indented by thumbnail
Hard	4.00 and higher	Difficult to indent

LEGEND AND NOMENCLATURE

	Standard Penetration Sample
	Liner-tube sample, obtained by penetration of thick wall sampler containing 2 in. diameter liner-tubes (California sampler).
	Undisturbed sample, obtained by penetration of minimal 3 in. diameter, thin wall tube or, where indicated, fixed-piston sampling head.
	NX core.
PP, tsf	Unconfined compressive strength in tsf estimated with pocket penetrometer.
TV, tsf	Undrained shear strength in tsf estimated with torvane.
NMC, %	Natural Moisture Content, %
LL	Liquid Limit
PI	Plasticity Index
Qu, ksf	Unconfined Compressive Strength (Laboratory), ksf
RQD = 80%	Percentage (80) of Rock Quality Designation
	Depth Groundwater enters at time of drilling.
	Groundwater Level at some specified time after drilling.

SAMPLING RESISTANCE

P	Sample pushed by hydraulic rig action.
3	Numbers indicate blows per 6 in. of sampler penetration when driven by a 140 lb hammer falling freely 30 in. The Standard Penetration
6	Resistance is the number of blows for the last 12 in. of penetration of the Standard Penetration sampler, e.g. 15.
9	Standard Penetration Resistance
15	Standard Penetration Resistance
50/2	Number of blows (50) used to drive the Standard Penetration Sampler a certain number of inches (2).

ABBREVIATIONS USED UNDER "FIELD NOTES"

HSA	Hollow Stem Auger
CFA	Continuous Flight Auger
ATD	At Time of Drilling
AD	After Drilling
DWL	Drill Water Loss
DWR	Drill Water Return

LOG of BORING No. GB-1

Sheet 1 of 2

DATE 11/8/99 SURFACE ELEVATION, FT 407.0 DATUM USGS LOCATION See Figure 1

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	PP, TSF	FIELD Qu, KSF	NMC, %	IL	PI	Qu, KSF	NOTES
0				Firm, dark brown, moist, low plasticity Silty CLAY (CL)									Boring advanced with 4 1/4in. I.D HSA and Mud rotary
4			100		405.2								
3				Loose tan, dry, fine Sandy SILT (ML)	1.8								
3										14			
			83										
5								0.5		20			
			83	Becoming moist				0.5		19			
										18			
										22			
										28			
					398.0					33			
										35			
										32			
10			100	Very loose, tan, wet, SILT (ML); with trace of clay and some fine sand	9.0								
				Becoming loose						33			
					392.5								
15				Loose, wet, tan, fine Silty SAND (SM)	14.5								Switch to Mud Rotary
										37			
					388.0								
20			83	Medium dense, tan, wet fine Sandy SILT, to Silty SAND (SM/ML)	19.0								
										32			
					383.5								
			72	Medium dense, tan, wet, medium to fine Silty SAND (SM)	23.5								

Completion Depth: 48.5 Ft.Water Depth: 10 ft., After ATD hrs.Project No.: 2399STL022

_____ ft., After _____ hrs.

Project Name: Solutia

_____ ft., After _____ hrs.

Drilling Contractor: RediLogged by: Tim Hicks

Figure A-1

LOG of BORING No. GB-1										Sheet 2 of 2			
DATE		SURFACE ELEVATION, FT		DATUM		LOCATION		See Figure 1					
DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	PP, TSF	FIELD Qu, KSF	NMC, %	LL	PI	Qu, KSF	NOTES
25													
6			83	Becoming gray, medium dense, medium to fine gravel									
10													
15													
30				Medium dense, gray Silty SAND (SM); with trace of medium to fine gravel									
16			83	Becoming dense and less silty									
19													
21													
35													
10			67	Becoming medium dense									
12													
8													
40													
5			67	Becoming loose									
5													
4													
45				Loose, wet, gray Silty SAND (SM)									
16				Becoming medium dense									
11													
18													
				Bottom of boring at 48.5 ft.	48.5								

Completion Depth: 48.5 Ft.
 Project No.: 2399STL022
 Project Name: Solutia
 Drilling Contractor: Redi

Water Depth: 10 ft., After ATD hrs.
 _____ ft., After _____ hrs.
 _____ ft., After _____ hrs.
 Logged by: Tim Hicks

Figure A-2

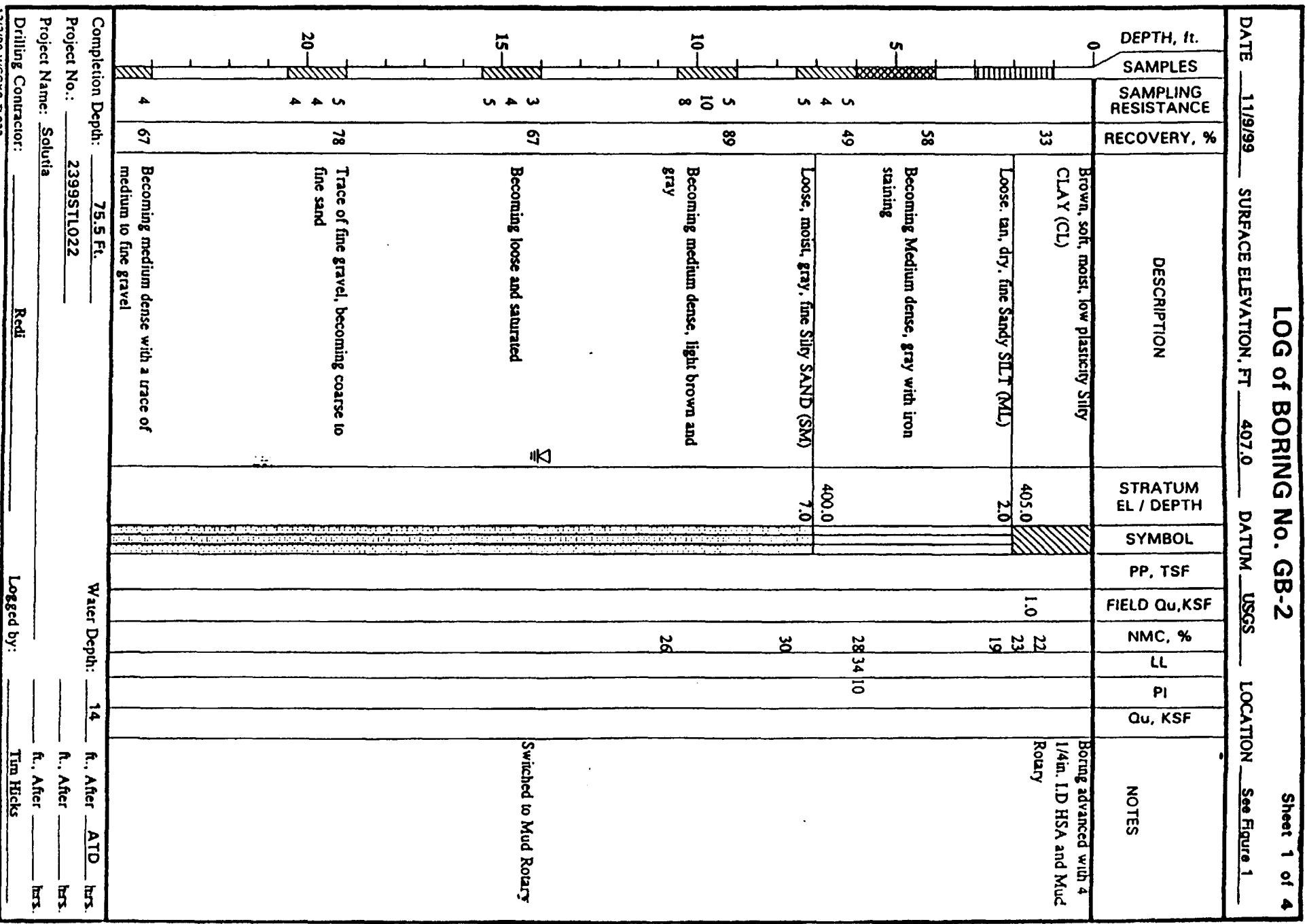


Figure A-2

LOG of BORING No. GB-2

Sheet 2 of 4

DATE 11/9/99 SURFACE ELEVATION, FT. 407.0 DATUM USGS LOCATION See Figure 1

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	PP, TSF	FIELD Qu, KSF	NMC, %	LL	PI	Qu, KSF	NOTES
25	6	10		Medium dense, gray, wet Silty SAND (SM); with a trace medium to fine gravel									
30	5	10		Medium dense, gray, wet Silty SAND (SM)									
35	15	19		Becoming dense									
40	9	20		With fine gravel, decrease in silt content									
45	5	6		Loose, medium dense, moist, gray coarse to fine SAND (SP); with some fine gravel									
	78				363.0								
	6	78			44.0								
					357.7								
					49.3								

Completion Depth: 75.5 Ft.

Water Depth: 14 ft., After ATD hrs.

Project No.: 2399STL022

ft., After hrs.

Project Name: Solulia

ft., After hrs.

Drilling Contractor: Redi

Logged by:

Tim Hicks

12/2/99 WCCS TLO22

URS Greiner Woodward Clyde

LOG of BORING No. GB-2										Sheet 3 of 4					
DATE		11/9/99		SURFACE ELEVATION, FT		407.0		DATUM		USGS		LOCATION		See Figure 1	
DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	PP, TSF	FIELD Qu, KSF	NMC, %	LL	PI	Qu, KSF	NOTES		
50	13	13		Medium dense, gray, moist, medium to fine SAND (SM/SP); with trace of silt						21					
					353.0										
55	30	100		Very dense, gray, moist, fine Silty SAND (SM)	54.0										
	39														
	40														
60				Very dense, gray, moist fine Silty SAND (SM)											
65	20	83		Becoming dense with some silt, coarse to fine sand, trace of fine gravel											
	18														
	19														
70															
					333.0										
	16	83			74.0										

Completion Depth:	75.5 Ft.	Water Depth:	14	ft., After	ATD	hrs.
Project No.:	2399STL022			ft., After		hrs.
Project Name:	Solutia			ft., After		hrs.
Drilling Contractor:	Redi	Logged by:	Tim Hicks			

LOG of BORING No. GB-2											Sheet 4 of 4		
DATE <u>11/9/99</u>		SURFACE ELEVATION, FT. <u>407.0</u>		DATUM <u>USGS</u>		LOCATION <u>See Figure 1</u>							
DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	PP, TSF	FIELD Qu, KSF	NMC, %	LL	PI	Qu, KSF	NOTES
75	16			Becoming medium dense, gray, wet,	331.5								
	13			coarse to fine gravel with medium to fine SAND (SP)	75.5								
				Bottom of boring at 75.5ft.									
80													
85													
90													
95													

Completion Depth: <u>75.5 Ft.</u>	Water Depth: <u>14</u> ft., After <u>ATD</u> hrs.
Project No.: <u>2399STL022</u>	<u> </u> ft., After <u> </u> hrs.
Project Name: <u>Solutia</u>	<u> </u> ft., After <u> </u> hrs.
Drilling Contractor: <u>Redi</u>	Logged by: <u>Tim Hicks</u>

LOG of BORING No. GB-3

DATE 11/10/99 SURFACE ELEVATION, FT 407.5 DATUM USGS LOCATION See Figure 1

Completion Depth: 50.5 Ft. Water Depth: 10.5 f., After ATD hrs.

Project No.: 2399ST1022 f., After _____ hrs.

Project Name: Solutia f., After _____ hrs.

Drilling Contractor: Redi Logged by: Tim Hicks

URS Greiner Woodward Clyde

Sheet 2 of 3

DATE 11/10/99 SURFACE ELEVATION, FT 407.5 DATUM USGS LOCATION See Figure 1

Completion Depth: <u>50.5 Ft.</u>	Water Depth: <u>10.5</u> ft., After <u>ATD</u> hrs.
Project No.: <u>2399STL022</u>	_____ ft., After _____ hrs.
Project Name: <u>Solutia</u>	_____ ft., After _____ hrs.
Drilling Contractor: <u>Redi</u>	Logged by: <u>Tim Hicks</u>

Figure A-3

LOG of BORING No. GB-3										Sheet 3 of 3			
DATE 11/10/99		SURFACE ELEVATION, FT 407.5		DATUM USGS		LOCATION See Figure 1							
DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	PP, TSF	FIELD Qu, KSF	NMC, %	LL	PI	Qu, KSF	NOTES
50	11				357.0								
	14			Bottom of boring at 50.5 ft.	50.5								
55													
60													
65													
70													

Completion Depth: 50.5 Ft.	Water Depth: 10.5	f., After	ATD	hrs.
Project No.: 2399STL022		f., After		hrs.
Project Name: Solutia		f., After		hrs.
Drilling Contractor: Redi	Logged by: Tim Hicks			

12/2/99 WCCXS TL022

URS Greiner Woodward Clyde

LOG of BORING No. HA-1

DATE 11/15/99 SURFACE ELEVATION, FT 401.0 DATUM USGS LOCATION See Figure 1.

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	PP, TSF	FIELD Qu, KSF	NMC, %	LL	PI	Qu, KSF	NOTES
0				Firm, dark brown, low to medium Silty CLAY (CL)									
					399.5								
				Loose, tan, fine Sandy SILT (SM); with trace of clay ML	1.5								
					399.0								
				Bottom of Hand Auger at 2ft.	2.0								
5													

Completion Depth: 2.0 Ft.

Water Depth: _____ ft., After _____ hrs.

Project No.: 2399STL022

_____ ft., After _____ hrs.

Project Name: Solutia

_____ ft., After _____ hrs.

Drilling Contractor: RediLogged by: Tim Hicks

Figure A-5

LOG of BORING No. HA-2											Sheet 1 of 1		
DATE <u>11/15/99</u>		SURFACE ELEVATION, FT <u>400.0</u>		DATUM <u>USGS</u>		LOCATION <u>See Figure 1.</u>							
DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	PP, TSF	FIELD Qu, KSF	NMC, %	LL	PI	Qu, KSF	NOTES
0				Firm, dark brown, low to medium plasticity Silty CLAY (CL)	398.5								
				Loose, tan, fine Sandy SILT (SM); with trace of clay	1.5 398.0								
				Bottom of Hand Auger at 2ft.	2.0								
5													

Completion Depth: 2.0 Ft. Water Depth: _____ ft., After _____ hrs.
 Project No.: 2399STL022 _____ ft., After _____ hrs.
 Project Name: Solutia _____ ft., After _____ hrs.
 Drilling Contractor: Redi Logged by: Tim Hicks

LOG of BORING No. GB-4

Sheet 1 of 1

DATE 11/7/00 SURFACE ELEVATION, FT 402.0 DATUM USGS LOCATION _____

DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	PP, TSF	FIELD Qu, KSF	NMC, %	LL	PI	Qu, KSF	NOTES
0	P	96		Soft, moist, low plasticity Silty CLAY (CL)	400.7				24	37	11.4		Boring advanced with 4 1/4 in. I.D. 9 in. O.D. HSA
				Very loose, moist, light brown to gray, fine SAND (SP)	1.3				14				
	P	86		Firm, moist, dark brown Silty CLAY (CL)	399.6				14				
					2.4				11				
					398.0				30				
	3	92		Very loose, moist, light brown to gray, Silty SAND (SM)	4.0				27	34	17		
				Loose, moist, brownish gray, Sandy SILT (ML)	397.0				21				
	4	83		Becomes very loose, wet, light brown	5.0								
	2	88							35				
	WH/2	83		Becomes gray									
10					390.0								
	WH			Very soft, wet, gray, low plastic Silty CLAY (CL)	12.0				35	38	21		
					388.1								
	P	67		Loose, wet, gray SILT (ML)	13.9								
				Firm, gray, high plastic CLAY (CH)	387.2				26				Clay lens, 10 in. thick
				Medium dense, wet, gray, SILT (CL-ML); trace sand	14.8								
	10	75			386.5								
					15.5								
	7	67			383.5								
				Loose, wet, gray, Silty SAND (SM)	18.5				27				
					382.0								
20				Bottom of boring at 20 ft.	20.0								

Completion Depth: 20.0 Ft.Water Depth: 15.5 ft., After ATD hrs.Project No.: 2399ST10227.1 ft., After 3 hrs.Project Name: Solida

ft., After _____ hrs.

Drilling Contractor: _____

Hartiss Drilling

Logged by: _____

Martin Swanson

12/15/00 WCGAS T1022

URS Corporation

Completion Depth:	20.0 Ft.	Water Depth:	15	f.. After	ATD	hrs.
Project No.:	2399STL022		8	f.. After	1	hrs.
Project Name:	Solutia			f.. After		hrs.
Drilling Contractor:	Harriss Drilling	Logged by:			Martin Swanson	

Figure A-8

LOG of BORING No. PZ-1											Sheet 1 of 1				
DATE		11/8/99		SURFACE ELEVATION, FT		402.0		DATUM		USGS		LOCATION		See Figure 1	
DEPTH, ft.	SAMPLES	SAMPLING RESISTANCE	RECOVERY, %	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	PP, TSF	FIELD Qu, KSF	NMC, %	LL	PI	Qu, KSF	NOTES		
0				Soft, moist, brown, low plasticity Silty CLAY									Boring advanced with 4 1/4 in. I.D HSA		
	2		100												
	4			Becoming stiff											
	5									31					
	2		100	Becoming firm, medium plasticity mottled brown, gray			1.5								
5	3														
	3									36	60	40			
	1		100												
	1														
	2			Very loose, wet, gray, Sandy SILT (ML); with medium to fine sand	394.8										
					7.2					36					
					392.5										
10				Loose, wet, gray, medium to fine SAND (SM); with some silt	9.5										
	1		78	Very loose, wet, tan, fine SAND (SM); with a trace of silt											
15	0														
	1														
	8		88	Becoming medium dense											
20	9				381.5										
	10			Bottom of boring at 20.5 ft.	20.5										

Completion Depth: 20.5 Ft.
 Project No.: 2399STL022
 Project Name: Solutia
 Drilling Contractor: Redi



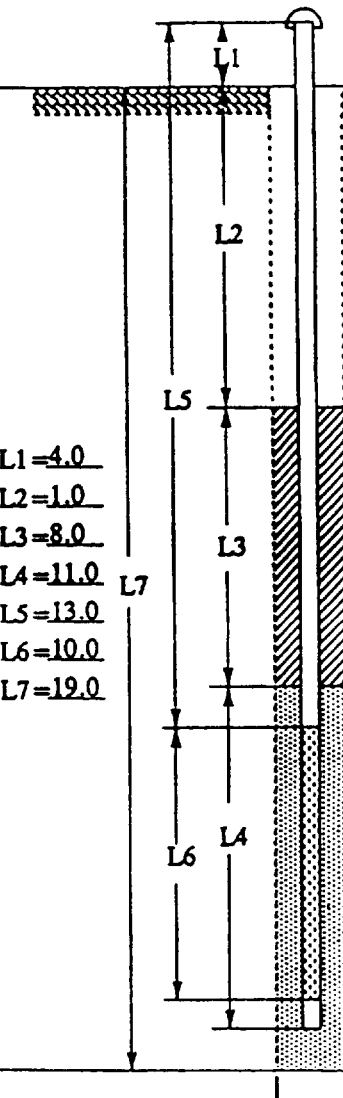



Water Depth: 9.5 ft., After ATD hrs.
10 ft., After 18 hrs.
 _____ ft., After _____ hrs.
 Logged by: Tim Hicks

12/2/99 WCCXS TL022
URS Greiner Woodward Clyde

MONITORING WELL INSTALLATION REPORT

Well No. PZ-1Location See Figure 1.Project SolutiaProject No 2399STL022 Installed By Redi Date 11/8/99 Time 1100Method of Installation 4 1/4 in. H.S.A. Done 1150

LOG OF BORING AND WELL

BORING			WELL	
Depth in Ft.	Description	Symbol	Type of Well	
0.00	Soft, moist, brown, low plasticity Silty CLAY Becoming stiff Becoming firm, medium plasticity mottled brown, gray		Ground Elev. <u>401.8</u>	Top of Riser Elev. <u>405.8</u>
7.20	Very loose, wet, gray, Sandy SILT (ML); with medium to fine sand			
9.50	Loose, wet, gray, medium to fine SAND (SM); with some silt			
	Very loose, wet, tan, fine SAND (SM); with a trace of silt			
	Becoming medium dense			
	Bottom of boring at 20.5ft.		L1 = <u>4.0</u> L2 = <u>1.0</u> L3 = <u>8.0</u> L4 = <u>11.0</u> L5 = <u>13.0</u> L6 = <u>10.0</u> L7 = <u>19.0</u>	Riser Pipe I.D., in. <u>1in.</u> Type of Pipe <u>PVC</u> Backfill Type Around Riser <u>Portland cement</u> Top of Seal Elevation _____ Type of Seal Material <u>See below</u> Top of Filter Elevation <u>8.0</u> Type of Filter Material <u>Quartz</u> Size of Opening, in. <u>0.01</u> Diameter of Well Tip, in. <u>1.0</u> Bottom of Screen Elevation <u>19.0</u> Bottom of Riser Elevation <u>19.0</u> Btm of Boring Elev. <u>19.0</u> Diameter of Boring, in. <u>4.2</u>

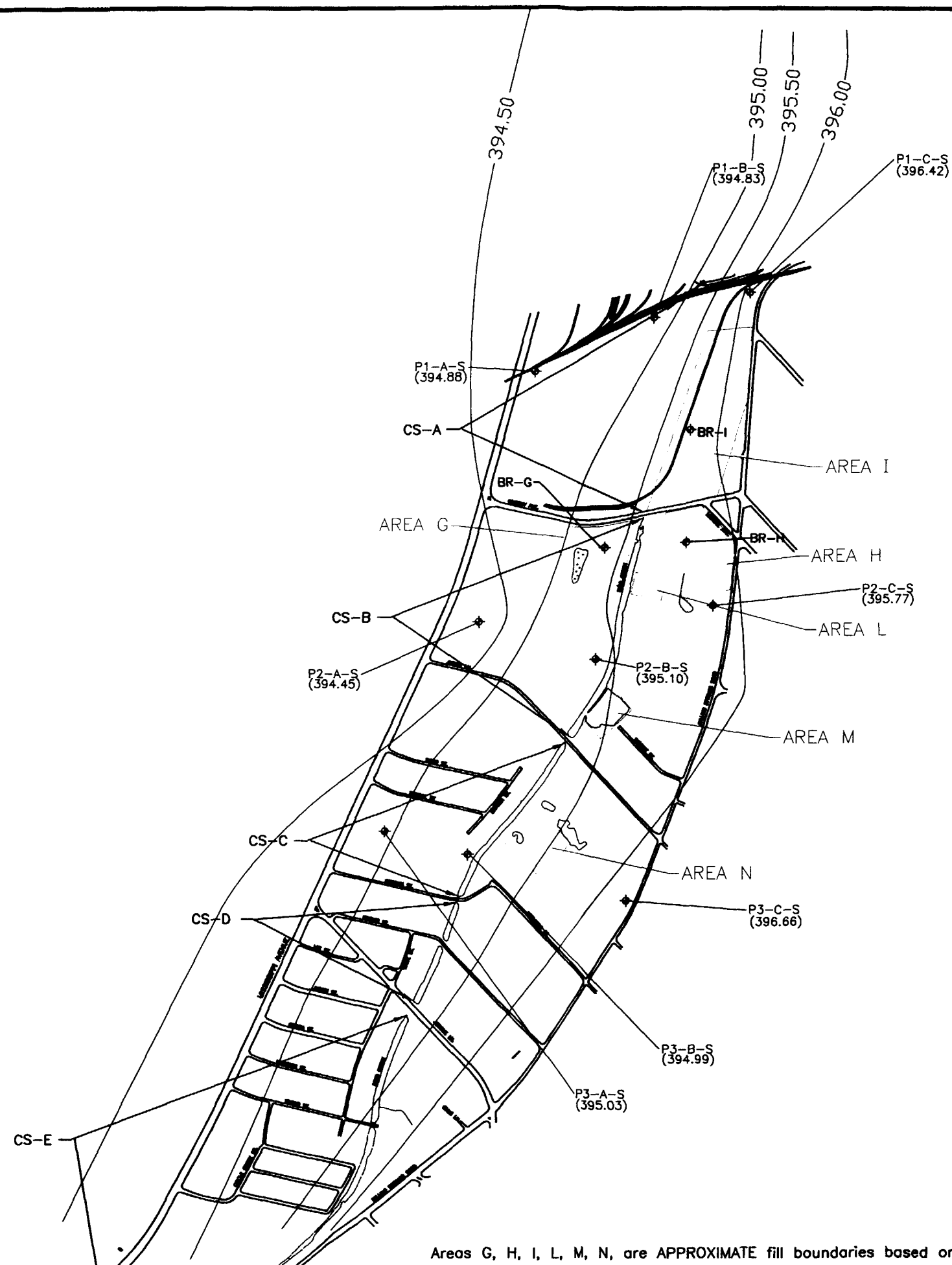
Remarks _____

Inspected By Tim Hicks

WOODWARD-CLYDE CONSULTANTS

Appendix B

Piezometric Surface Maps

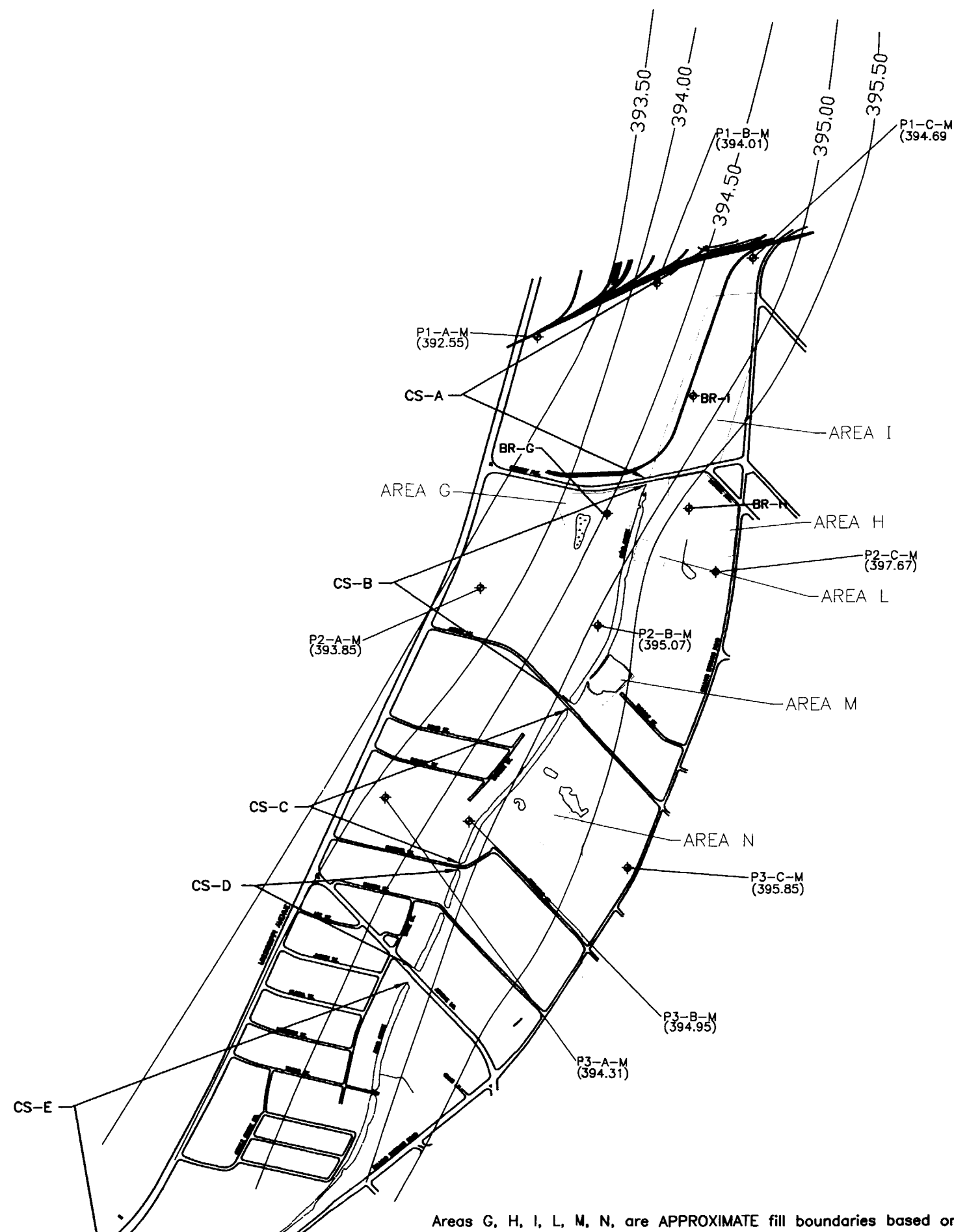


- LEGEND**
- ⊕ GROUND WATER SAMPLING LOCATION
 - CS-A CREEK SEGMENT
 - AREA H FILL AREA
 - WATER BODY
 - (395.77) POTENTIOMETRIC SURFACE
 - 394.50 — POTENTIOMETRIC CONTOUR

NOTE:
DRAWING DERIVED FROM O'BRIEN &
GERE DRAWING 25501.FIG 1
FIGURE 1 DATED
SEPTEMBER 2000



Title: POTENTIOMETRIC SURFACE MAP OF THE SHALLOW ZONE ALLUVIAL AQUIFER FIRST QUARTER, 2000			
SAUGET AND CAHOKIA, ILLINOIS			
Prepared For: SOLUTIA INC. ST. LOUIS, MISSOURI			
ROUX ROUX ASSOCIATES, INC. Environmental Consulting & Management	Compiled by: L.W.R.	Date: 12/00	FIGURE 4-43
	Prepared by: M.J.S.	Scale: AS SHOWN	
	Project Mgr: J.R.L.	Office: TX	
	File No: 48704.PMS1	Project: 08648T04	



- LEGEND**
- ★ GROUND WATER SAMPLING LOCATION
 - CS-A CREEK SEGMENT
 - AREA H FILL AREA
 - WATER BODY
 - (395.77) POTENTIOMETRIC SURFACE
 - 394.50 — POTENTIOMETRIC CONTOUR

NOTE:
DRAWING DERIVED FROM O'BRIEN &
GERE DRAWING 25501.FIG 1
FIGURE 1 DATED
SEPTEMBER 2000

1000 0 1000
SCALE IN FEET

**TITLE: POTENTIOMETRIC SURFACE MAP
OF THE INTERMEDIATE ZONE
ALLUVIAL AQUIFER
FIRST QUARTER, 2000**

SAUGET AND CAHOKIA, ILLINOIS

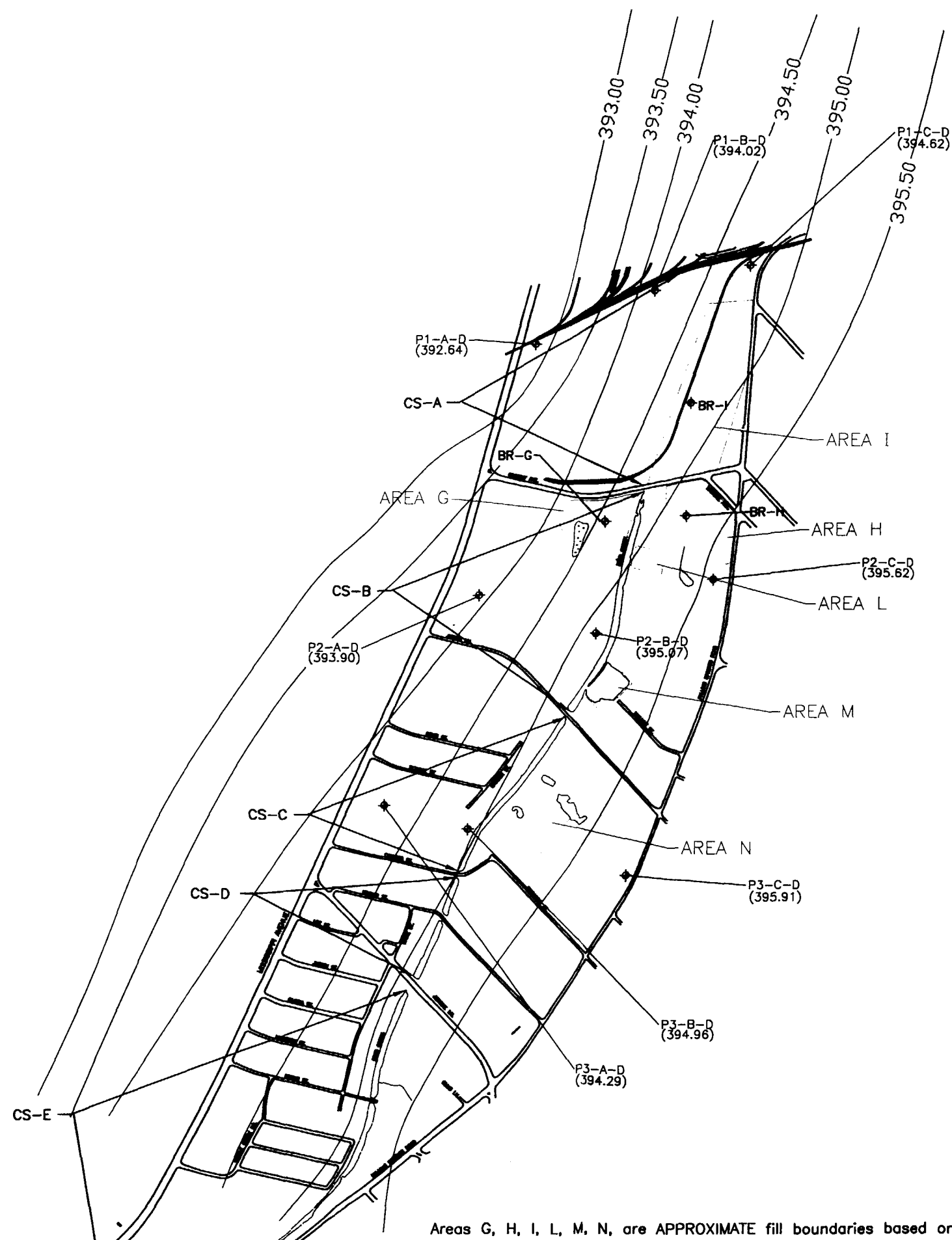
Prepared For: **SOLUTIA INC.
ST. LOUIS, MISSOURI**

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting
& Management

Compiled by: L.W.R.	Date: 12/00
Prepared by: M.J.S.	Scale: AS SHOWN
Project Mgr: J.R.L.	Office: TX
File No: 48704.PMS5	Project: 06848T04

FIGURE
4-44

Areas G, H, I, L, M, N, are APPROXIMATE fill boundaries based on aerial photo review.



- LEGEND**
- ⊕ GROUND WATER SAMPLING LOCATION
 - CS-A CREEK SEGMENT
 - AREA H FILL AREA
 - WATER BODY
 - (395.77) POTENTIOMETRIC SURFACE
 - 394.50 — POTENTIOMETRIC CONTOUR

NOTE:
DRAWING DERIVED FROM O'BRIEN &
GERE DRAWING 25501.FIG 1
FIGURE 1 DATED
SEPTEMBER 2000

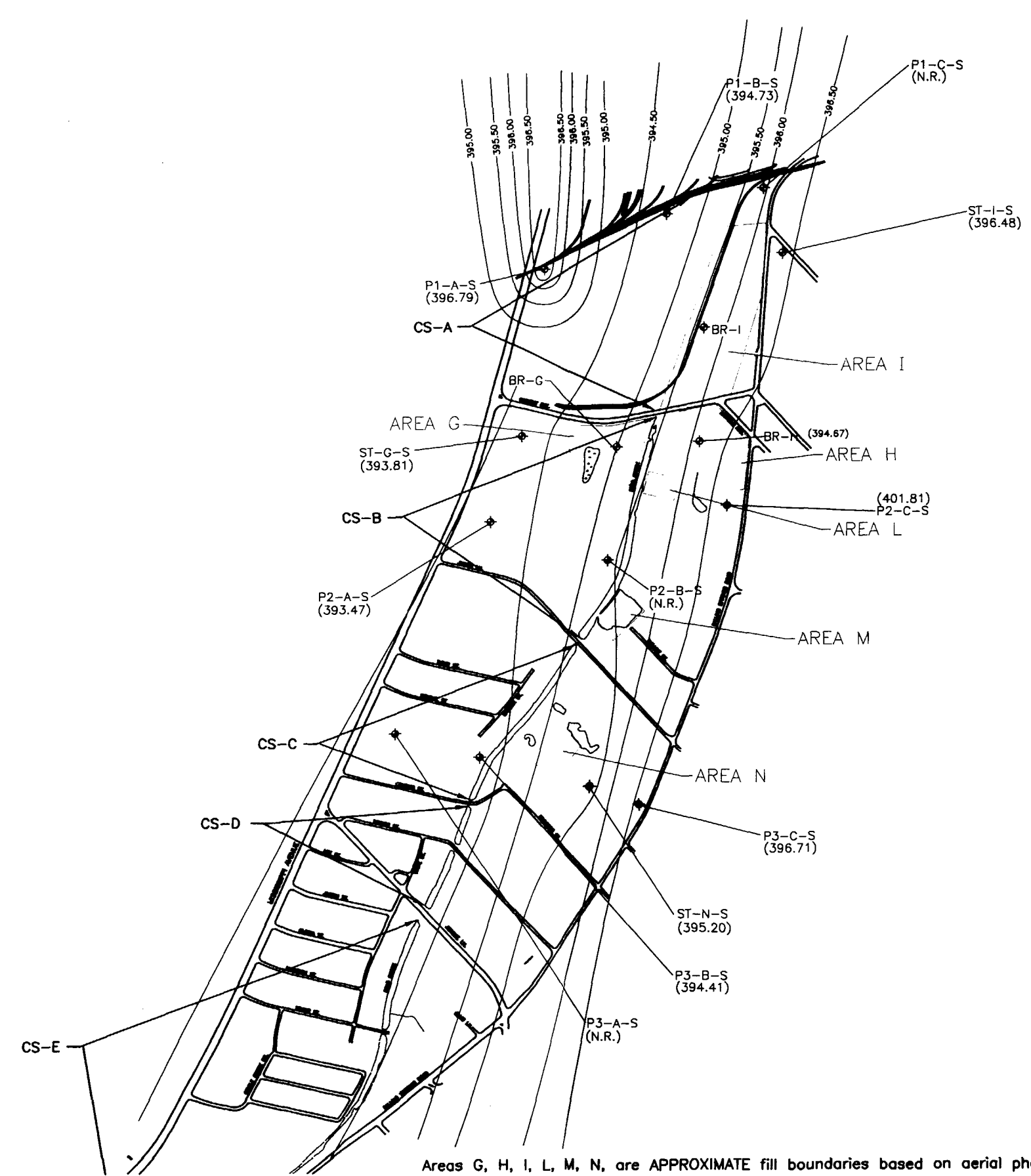
1000 0 1000
SCALE IN FEET

Title: POTENTIOMETRIC SURFACE MAP OF THE DEEP ZONE ALLUVIAL AQUIFER FIRST QUARTER, 2000			
SAUGET AND CAHOKIA, ILLINOIS			
Prepared For: SOLUTIA INC. ST. LOUIS, MISSOURI			
ROUX ROUX ASSOCIATES, INC. Environmental Consulting & Management	Compiled by: L.W.R.	Date: 12/00	FIGURE 4-45
	Prepared by: M.J.S.	Scale: AS SHOWN	
	Project Mgr: J.R.L.	Office: TX	
	File No: 46704.PMS6	Project: 06646T04	

Areas G, H, I, L, M, N, are APPROXIMATE fill boundaries based on aerial photo review.



- LEGEND**
- ◆ GROUND WATER SAMPLING LOCATION
 - CS-A CREEK SEGMENT
 - AREA H FILL AREA
 - WATER BODY
 - (395.77) POTENTIOMETRIC SURFACE
 - POTENTIOMETRIC CONTOUR

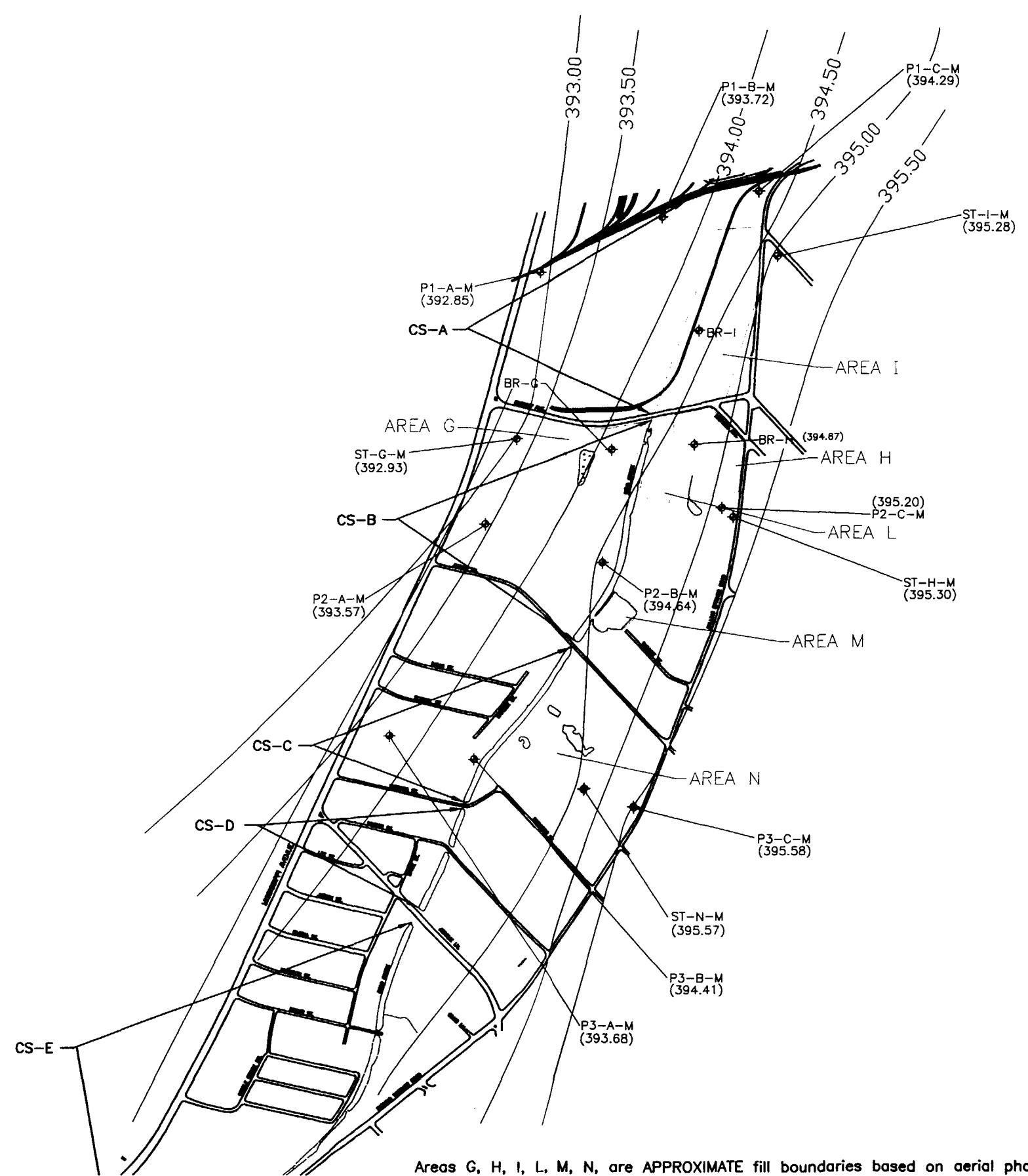


Areas G, H, I, L, M, N, are APPROXIMATE fill boundaries based on aerial photo review.

NOTE:
DRAWING DERIVED FROM O'BRIEN &
GERE DRAWING 25501.FIG 1
FIGURE 1 DATED
SEPTEMBER 2000



Title: POTENTIOMETRIC SURFACE MAP OF THE SHALLOW ZONE ALLUVIAL AQUIFER SECOND QUARTER, 2000			
SAUGET AND CAHOKIA, ILLINOIS			
Prepared For: SOLUTIA INC. ST. LOUIS, MISSOURI			
ROUX ROUX ASSOCIATES, INC. Environmental Consulting & Management	Compiled by: L.W.R.	Date: 12/00	FIGURE 4-46
	Prepared by: M.J.S.	Scale: AS SHOWN	
	Project Mgr: J.R.L.	Office: TX	
	File No: 48704.PMS3	Project: 08648T04	



LEGEND

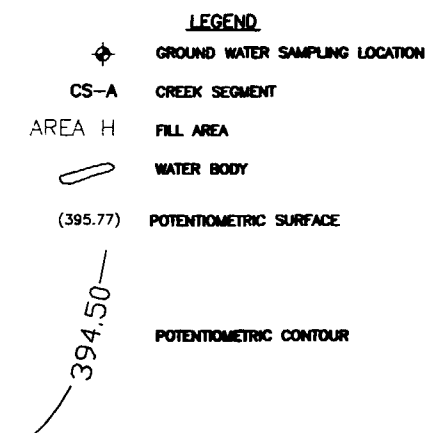
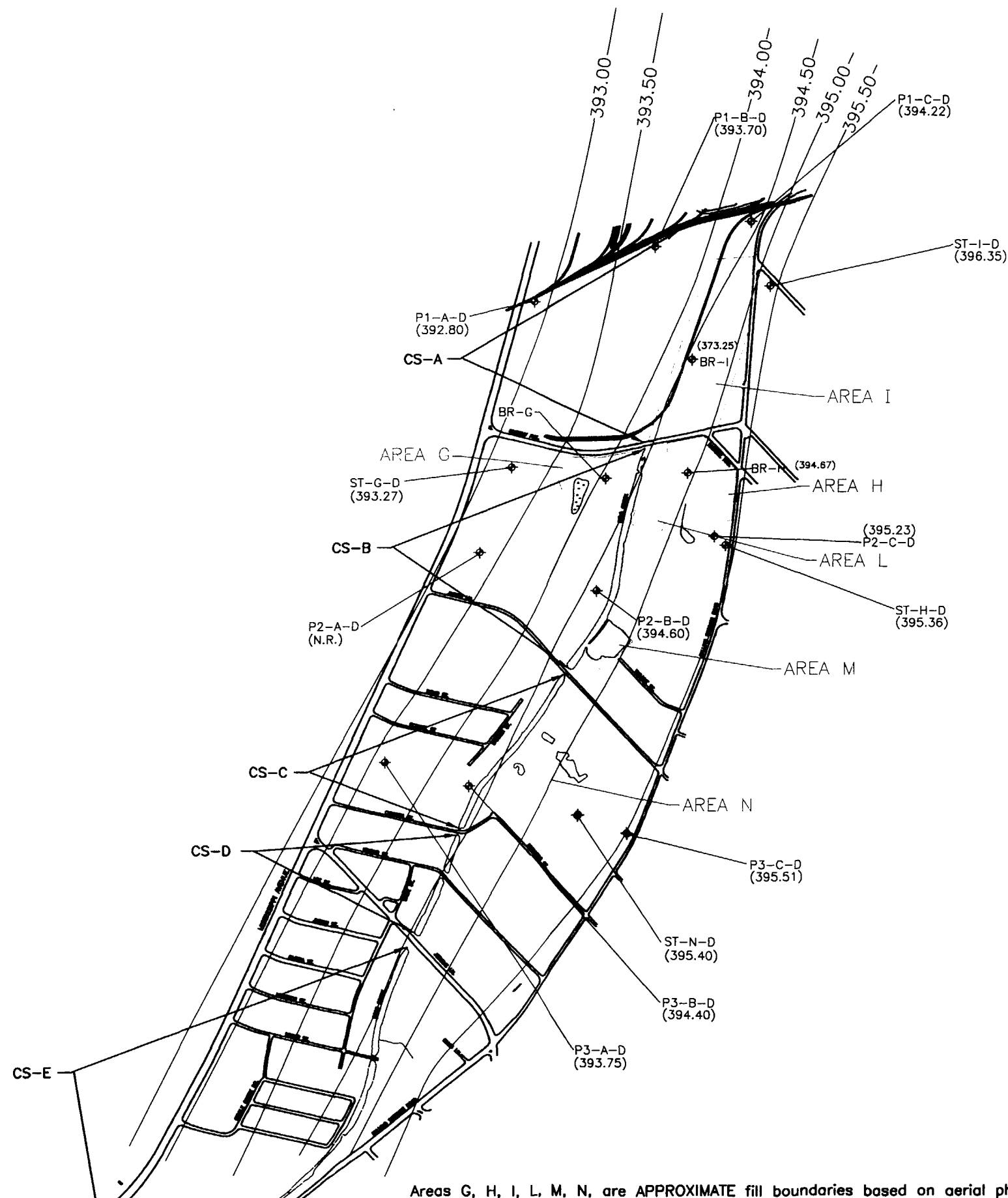
- ◆ GROUND WATER SAMPLING LOCATION
- CS-A CREEK SEGMENT
- AREA H FILL AREA
- WATER BODY
- (395.77) POTENTIOMETRIC SURFACE
- 394.50 POTENTIOMETRIC CONTOUR

NOTE:
DRAWING DERIVED FROM O'BRIEN &
GERE DRAWING 25501.FIG 1
FIGURE 1 DATED
SEPTEMBER 2000



Areas G, H, I, L, M, N, are APPROXIMATE fill boundaries based on aerial photo review.

Title: POTENTIOMETRIC SURFACE MAP OF THE INTERMEDIATE ZONE ALLUVIAL AQUIFER SECOND QUARTER, 2000			
SAUGET AND CAHOKIA, ILLINOIS			
Prepared For: SOLUTIA INC. ST. LOUIS, MISSOURI			
ROUX ROUX ASSOCIATES, INC. Environmental Consulting & Management	Compiled by: L.W.R.	Date: 12/00	FIGURE 4-47
	Prepared by: M.J.S.	Scale: AS SHOWN	
	Project Mgr: J.R.L.	Office: TX	
	File No: 46704.PMS4	Project: 06646TD4	



NOTE:
DRAWING DERIVED FROM O'BRIEN &
GERE DRAWING 25501.FIG 1
FIGURE 1 DATED
SEPTEMBER 2000



Areas G, H, I, L, M, N, are APPROXIMATE fill boundaries based on aerial photo review.

Title: POTENTIOMETRIC SURFACE MAP OF THE DEEP ZONE ALLUVIAL AQUIFER SECOND QUARTER, 2000			
SAUGET AND CAHOKIA, ILLINOIS			
Prepared For: SOLUTIA INC. ST. LOUIS, MISSOURI			
ROUX ROUX ASSOCIATES, INC. Environmental Consulting & Management	Compiled by: L.W.R.	Date: 12/00	FIGURE 4-48
	Prepared by: M.J.S.	Scale: AS SHOWN	
	Project Mgr: J.R.L.	Office: TX	
	File No: 46704.PMS2	Project: 06846T04	

Appendix C

ASTM Standard D6312-98



Standard Guide for Developing Appropriate Statistical Approaches for Ground- Water Detection Monitoring Programs¹

This standard is issued under the fixed designation D 6312; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers the context of ground-water monitoring at waste disposal facilities, regulations have required statistical methods as the basis for investigating potential environmental impact due to waste disposal facility operation. Owner/operators must perform a statistical analysis on a quarterly or semiannual basis. A statistical test is performed on each of many constituents (for example, 10 to 50 or more) for each of many wells (5 to 100 or more). The result is potentially hundreds, and in some cases, a thousand or more statistical comparisons performed on each monitoring event. Even if the false positive rate for a single test is small (for example, 1 %), the possibility of failing at least one test on any monitoring event is virtually guaranteed. This assumes you have done the correct statistic in the first place.

1.2 This guide is intended to assist regulators and industry in developing statistically powerful ground-water monitoring programs for waste disposal facilities. The purpose of these methods is to detect a potential ground-water impact from the facility at the earliest possible time while simultaneously minimizing the probability of falsely concluding that the facility has impacted ground water when it has not.

1.3 When applied inappropriately existing regulation and guidance on statistical approaches to ground-water monitoring often suffer from a lack of statistical clarity and often implement methods that will either fail to detect contamination when it is present (a false negative result) or conclude that the facility has impacted ground water when it has not (a false positive). Historical approaches to this problem have often sacrificed one type of error to maintain control over the other. For example, some regulatory approaches err on the side of conservatism, keeping false negative rates near zero while false positive rates approach 100 %.

1.4 The purpose of this guide is to illustrate a statistical ground-water monitoring strategy that minimizes both false negative and false positive rates without sacrificing one for the other.

1.5 This guide is applicable to statistical aspects of ground-

water detection monitoring for hazardous and municipal solid waste disposal facilities.

1.6 It is of critical importance to realize that on the basis of a statistical analysis alone, it can never be concluded that a waste disposal facility has impacted ground water. A statistically significant exceedance over background levels indicates that the new measurement in a particular monitoring well for a particular constituent is inconsistent with chance expectations based on the available sample of background measurements.

1.7 Similarly, statistical methods can never overcome limitations of a groundwater monitoring network that might arise due to poor site characterization, well installation and location, sampling, or analysis.

1.8 It is noted that when justified, intra-well comparisons are generally preferable to their inter-well counterparts because they completely eliminate the spatial component of variability. Due to the absence of spatial variability, the uncertainty in measured concentrations is decreased making intra-well comparisons more sensitive to real releases (that is, false negatives) and false positive results due to spatial variability are completely eliminated.

1.9 Finally, it should be noted that the statistical methods described here are not the only valid methods for analysis of ground-water monitoring data. They are, however, currently the most useful from the perspective of balancing site-wide false positive and false negative rates at nominal levels. A more complete review of this topic and the associated literature is presented by Gibbons (1).²

1.10 The values stated in both inch-pound and SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.11 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.12 *This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional*

¹ This guide is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Ground Water and Vadose Zone Investigations.

Current edition approved Sept. 10, 1998. Published December 1998.

² The boldface numbers given in parentheses refer to a list of references at the end of the text.

— *judgment. Not all aspects of this guide may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

2. Terminology

2.1 Definitions:

— 2.1.1 *assessment monitoring program, n*—ground-water monitoring that is intended to determine the nature and extent of a potential site impact following a verified statistically significant exceedance of the detection monitoring program.

— 2.1.2 *combined Shewart (CUSUM) control chart, n*—a statistical method for intra-well comparisons that is sensitive to both immediate and gradual releases.

— 2.1.3 *detection limit (DL), n*—the true concentration at which there is a specified level of confidence (for example, 99 % confidence) that the analyte is present in the sample (2).

— 2.1.4 *detection monitoring program, n*—ground-water monitoring that is intended to detect a potential impact from a facility by testing for statistically significant changes in geochemistry in a downgradient monitoring well relative to background levels.

— 2.1.5 *intra-well comparisons, n*—a comparison of one or more new monitoring measurements to statistics computed from a sample of historical measurements from that same well.

— 2.1.6 *inter-well comparisons, n*—a comparison of a new monitoring measurement to statistics computed from a sample of background measurements (for example, upgradient versus downgradient comparisons).

— 2.1.7 *prediction interval or limit, n*—a statistical estimate of the minimum or maximum concentration, or both, that will contain the next series of k measurements with a specified level of confidence (for example, 99 % confidence) based on a sample of n background measurements.

— 2.1.8 *quantification limit (QL), n*—the concentration at which quantitative determinations of an analyte's concentration in the sample can be reliably made during routine laboratory operating conditions (3).

2.2 Definitions of Terms Specific to This Standard:

— 2.2.1 *false negative rate, n*—in detection monitoring, the rate at which the statistical procedure does not indicate possible contamination when contamination is present.

— 2.2.2 *false positive rate, n*—in detection monitoring, the rate at which the statistical procedure indicates possible contamination when none is present.

— 2.2.3 *nonparametric, adj*—a term referring to a statistical technique in which the distribution of the constituent in the population is unknown and is not restricted to be of a specified form.

— 2.2.4 *nonparametric prediction limit, n*—the largest (or second largest) of n background samples. The confidence level associated with the nonparametric prediction limit is a function of n and k .

— 2.2.5 *parametric, adj*—a term referring to a statistical technique in which the distribution of the constituent in the

population is assumed to be known.

2.2.6 *verification resample, n*—in the event of an initial statistical exceedance, one (or more) new independent sample is collected and analyzed for that well and constituent which exceeded the original limit.

2.3 Symbols:

2.3.1 α —the false positive rate for an individual comparison (that is, one well and constituent).

2.3.2 α^* —the site-wide false positive rate covering all wells and constituents.

2.3.3 k —the number of future comparisons for a single monitoring event (for example, the number of downgradient monitoring wells multiplied by the number of constituents to be monitored) for which statistics are to be computed.

2.3.4 n —the number of background measurements.

2.3.5 σ^2 —the true population variance of a constituent.

2.3.6 s —the sample-based standard deviation of a constituent computed from n background measurements.

2.3.7 s^2 —the sample-based variance of a constituent computed from n background measurements.

2.3.8 μ —the true population mean of a constituent.

2.3.9 \bar{x} —the sample-based mean or average concentration of a constituent computed from n background measurements.

3. Summary of Guide

3.1 This guide is summarized in Figs. 1, that provides a flowchart illustrating the steps in developing a statistical monitoring plan. The monitoring plan is based either on background versus monitoring well comparisons (for example, upgradient versus downgradient comparisons or intra-well comparisons, or a combination of both). Fig. 1 illustrates the various decision points at which the general comparative strategy is selected (that is, upgradient background versus intra-well background) and how the statistical methods are to be selected based on site-specific considerations. The statistical methods include parametric and nonparametric prediction limits for background versus monitoring well comparisons and combined Shewart-CUSUM control charts for intra-well comparisons. Note that the background database is intended to expand as new data become available during the course of monitoring.

4. Significance and Use

4.1 The principal use of this guide is in ground-water detection monitoring of hazardous and municipal solid waste disposal facilities. There is considerable variability in the way in which existing Guide USEPA regulation and guidance are interpreted and practiced. Often, much of current practice leads to statistical decision rules that lead to excessive false positive or false negative rates, or both. The significance of this proposed guide is that it jointly minimizes false positive and false negative rates at nominal levels without sacrificing one error for another (while maintaining acceptable statistical power to detect actual impacts to ground-water quality (4)).

4.2 Using this guide, an owner/operator or regulatory agency should be able to develop a statistical detection monitoring program that will not falsely detect contamination when it is absent and will not fail to detect contamination when it is present.

Development of a Statistical Detection Monitoring Plan

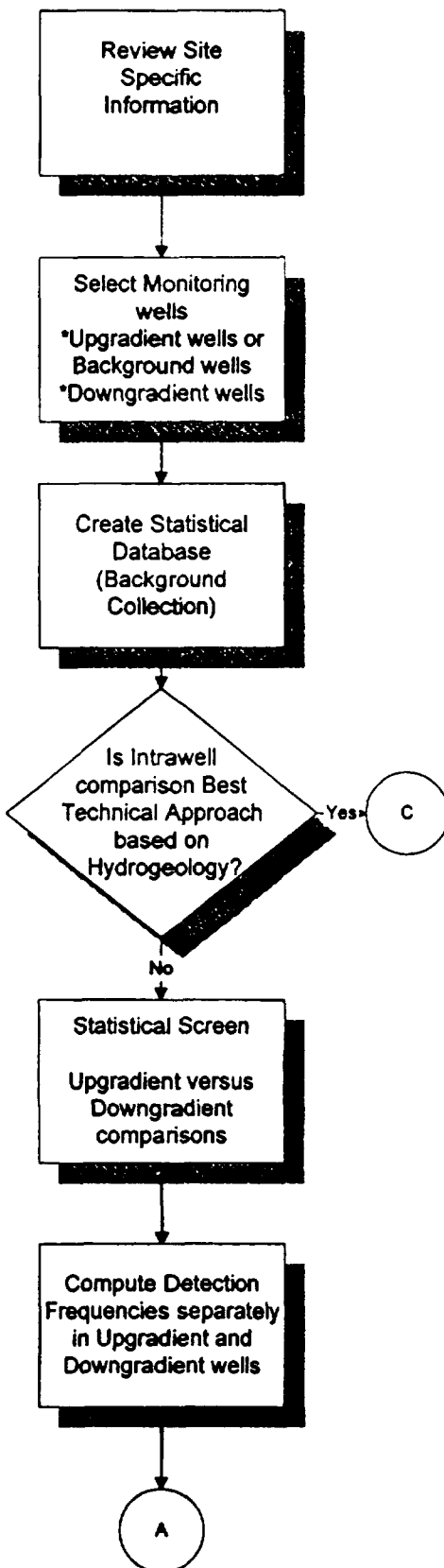


FIG. 1 Development of a Statistical Detection Monitoring Plan

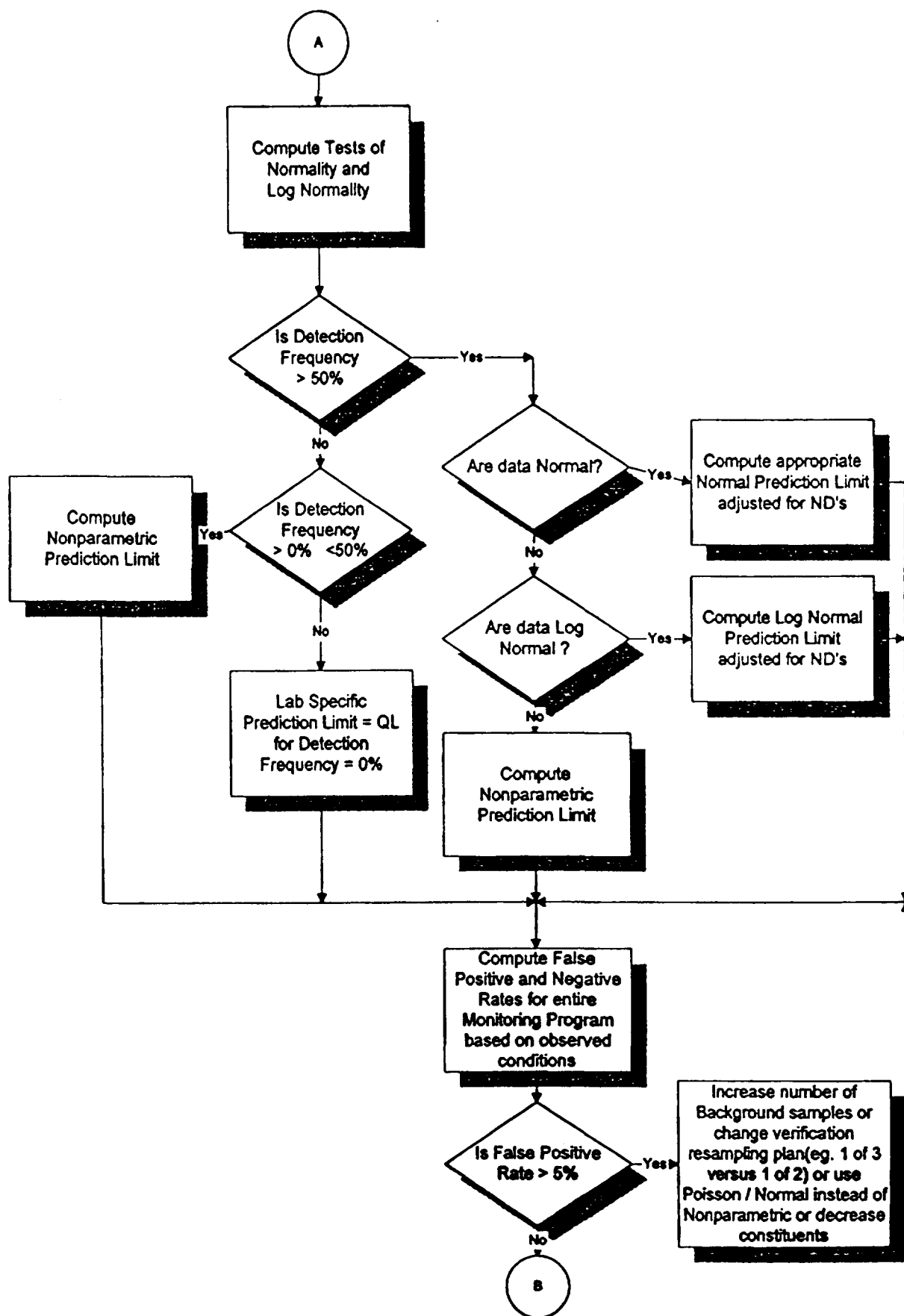


FIG. 1 (continued)

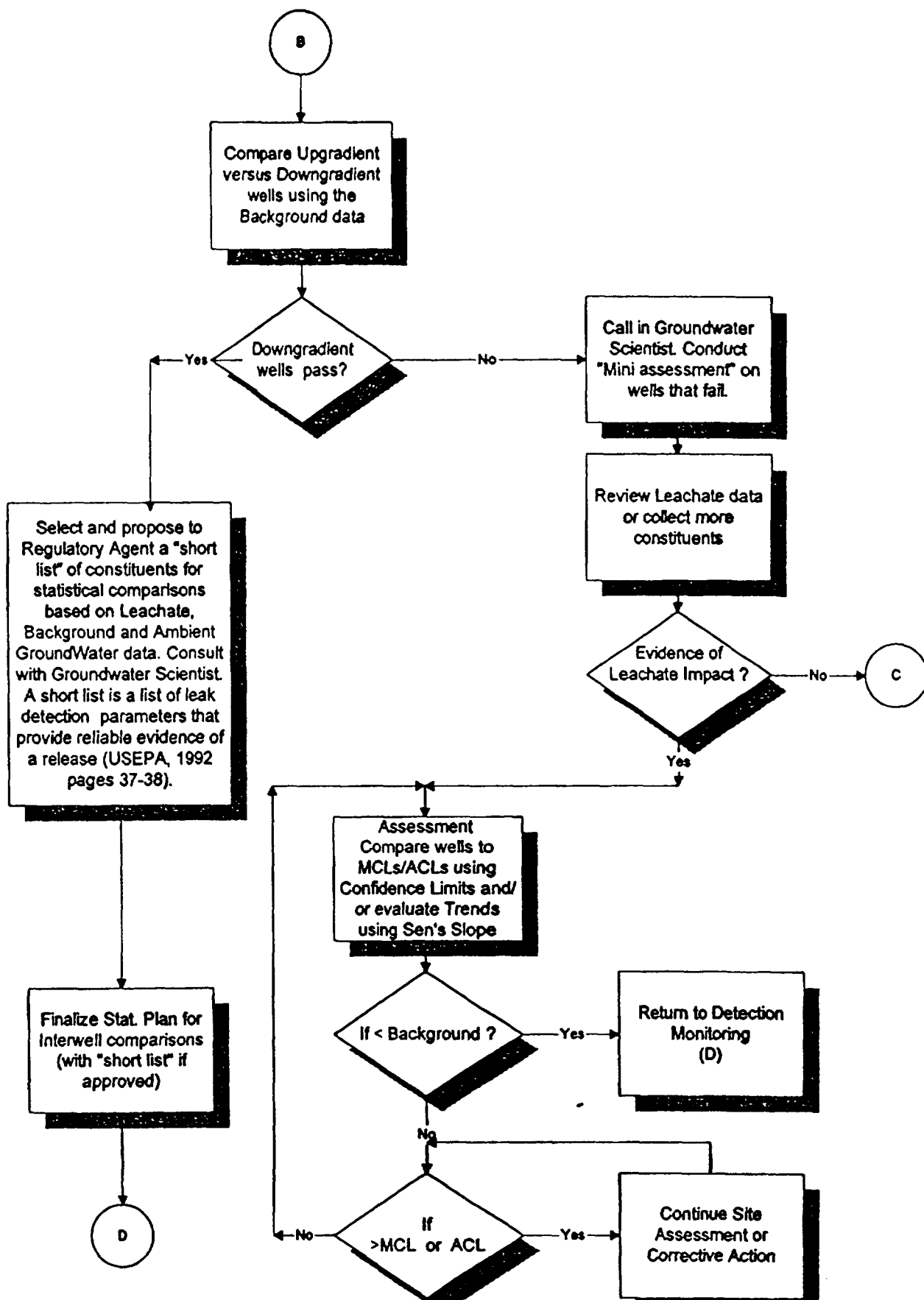


FIG. 1 (continued)

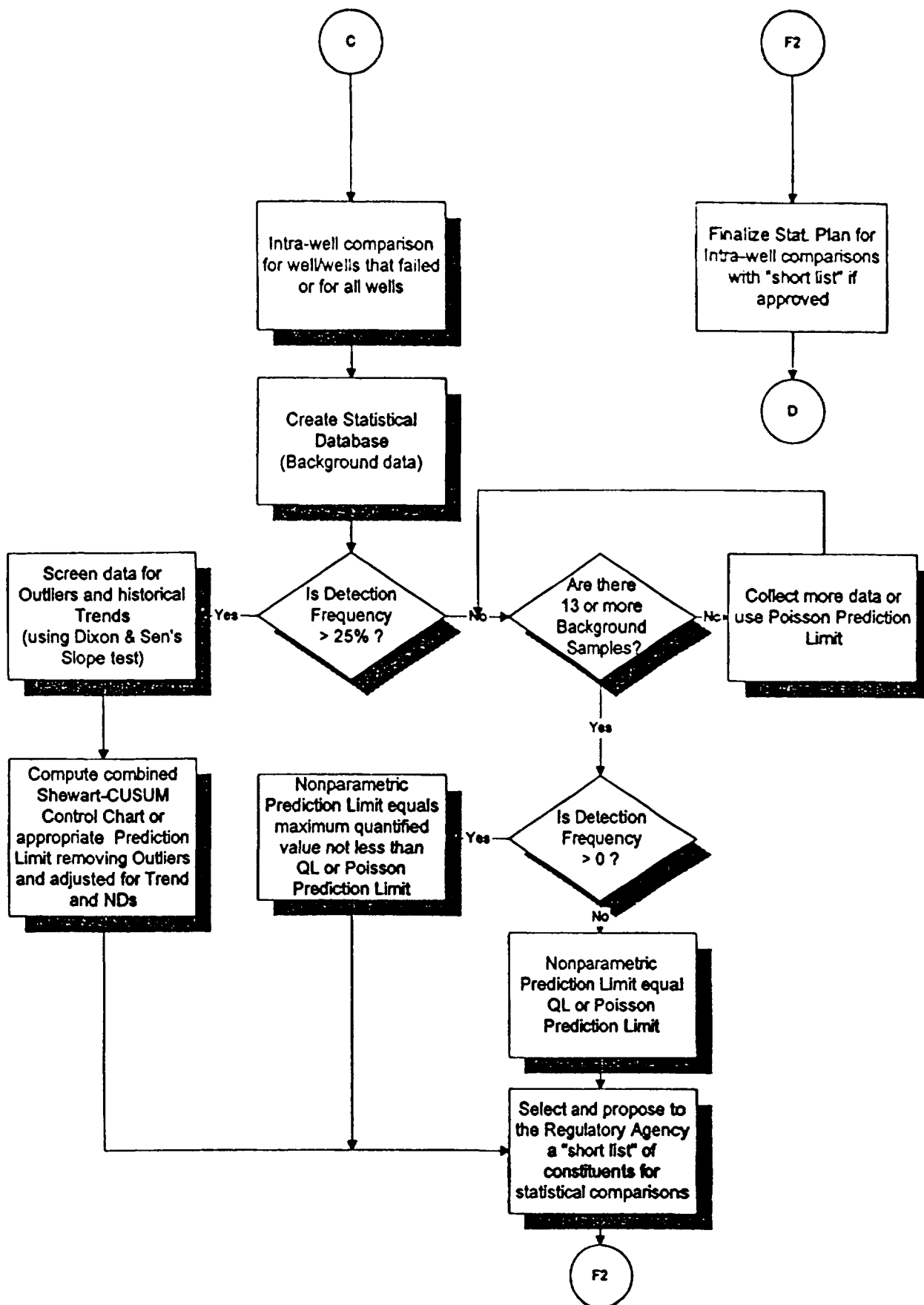


FIG. 1 (continued)

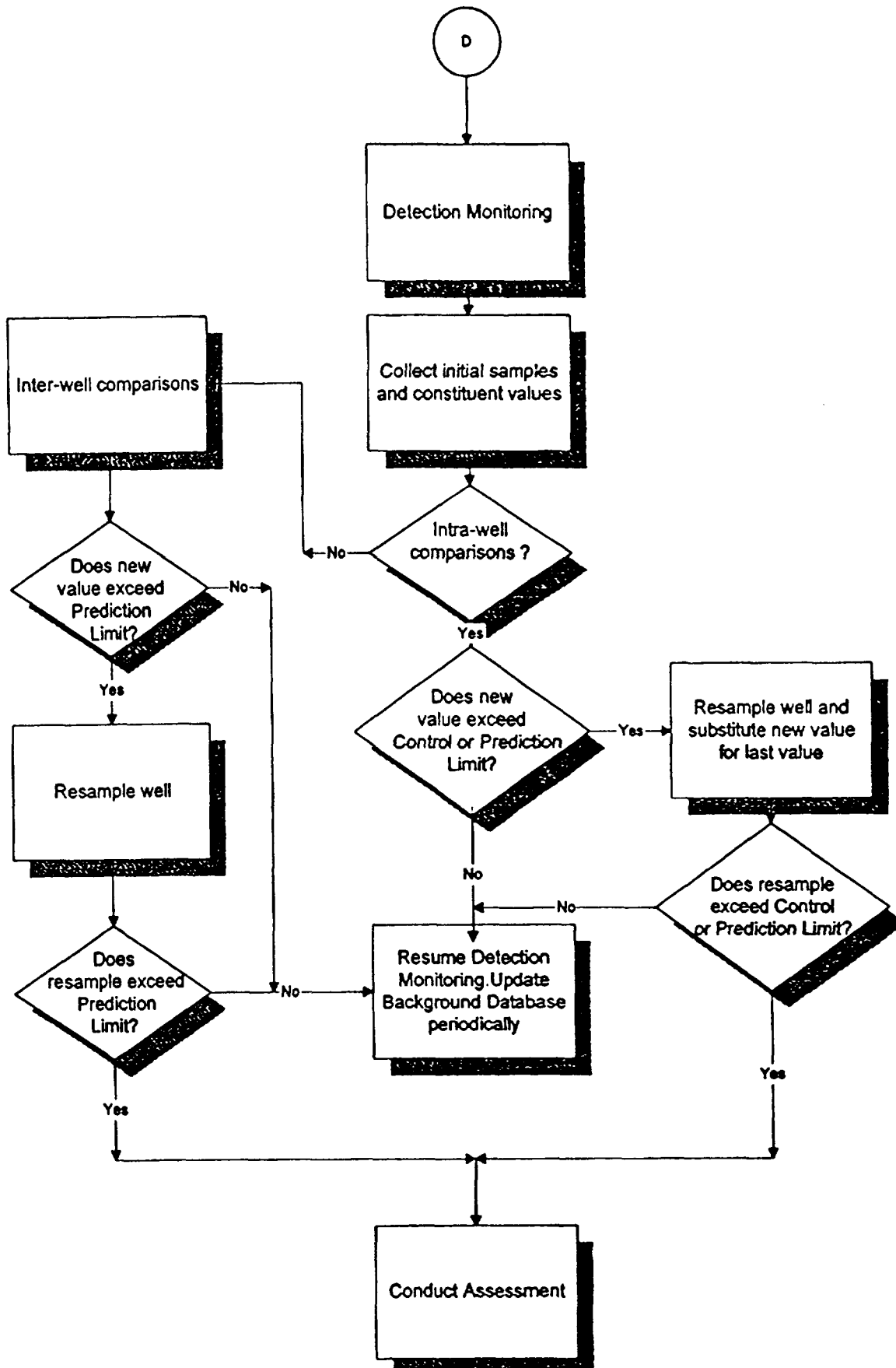


FIG. 1 (continued)

5. Procedure

Note 1—In the following, an overview of the general procedure is described with specific technical details described in Section 6.

5.1 Detection Monitoring:

5.1.1 Upgradient Versus Downgradient Comparisons:

5.1.1.1 Detection frequency $\geq 50\%$.

- 5.1.1.2 If the constituent is normally distributed, compute a normal prediction limit (5) selecting the false positive rate based on number of wells, constituents, and verification resamples (6) adjusting estimates of sample mean and variance for nondetects.

5.1.1.3 If the constituent is lognormally distributed, compute a lognormal prediction limit (7).

- 5.1.1.4 If the constituent is neither normally nor lognormally distributed, compute a nonparametric prediction limit (7) unless background is insufficient to achieve a 5 % site-wide false positive rate. In this case, use a normal distribution until sufficient background data are available (7).

5.1.1.5 If the background detection frequency is greater than zero but less than 50 %.

- 5.1.1.6 Compute a nonparametric prediction limit and determine if the background sample size will provide adequate protection from false positives.

- 5.1.1.7 If insufficient data exist to provide a site-wide false positive rate of 5 %, more background data must be collected.

- 5.1.1.8 As an alternative to 5.1.1.7 use a Poisson prediction limit which can be computed from any available set of background measurements regardless of the detection frequency (see 2.2.4 of Ref (4)).

- 5.1.1.9 If the background detection frequency equals zero, use the laboratory-specific QL (recommended) or limits required by applicable regulatory agency (8).³

- 5.1.1.10 This only applies for those wells and constituents that have at least 13 background samples. Thirteen samples provides a 99 % confidence nonparametric prediction limit with one resample for a single well and constituent (see Table 1).

- 5.1.1.11 If less than 13 samples are available more background data must be collected to use the nonparametric prediction limit.

- 5.1.1.12 An alternative would be to use a Poisson prediction limit that can be computed from four or more background measurements regardless of the detection frequency and can adjust for multiple wells and constituents.

5.1.1.13 If downgradient wells fail, determine cause.

- 5.1.1.14 If the downgradient wells fail because of natural or off-site causes, select constituents for intra-well comparisons (9).

- 5.1.1.15 If site impacts are found, a site plan for assessment monitoring may be necessary (10).

5.1.2 Intra-well Comparisons:

- 5.1.2.1 For those facilities that either have no definable hydraulic gradient, have no existing contamination, have too few background wells to meaningfully characterize spatial

variability (for example, a site with one upgradient well or a facility in which upgradient water quality is either inaccessible or not representative of downgradient water quality), compute intra-well comparisons using combined Shewart-CUSUM control charts (9).⁴

5.1.2.2 For those wells and constituents that fail upgradient versus downgradient comparisons, compute combined Shewart-CUSUM control charts. If no volatile organic compounds (VOCs) or hazardous metals are detected and no trend is detected in other indicator constituents, use intra-well comparisons for detection monitoring of those wells and constituents.

5.1.2.3 If data are all non-detects after 13 quarterly sampling events, use the QL as the nonparametric prediction limit (8). Thirteen samples provides a 99 % confidence nonparametric prediction limit with one resample (1). Note that 99 % confidence is equivalent to a 1 % false positive rate, and pertains to a single comparison (that is, well and constituent) and not the site-wide error rate (that is, all wells and constituents) that is set to 5 %.

5.1.2.4 If detection frequency is greater than zero (that is, the constituent is detected in at least one background sample) but less than 25 %, use the nonparametric prediction limit that is the largest (or second largest) of at least 13 background samples.

5.1.2.5 As an alternative to 5.1.2.3 and 5.1.2.4 compute a Poisson prediction limit following collection of at least four background samples. Since the mean and variance of the Poisson distribution are the same, the Poisson prediction limit is defined even if there is no variability (for example, even if the constituent is never detected in background). In this case, one half of the quantification limit is used in place of the measurements, and the Poisson prediction limit can be computed directly.

5.1.3 Verification Resampling:

5.1.3.1 Verification resampling is an integral part of the statistical methodology (see Section 5 of Ref (4)). Without verification resampling much larger prediction limits would be required to obtain a site-wide false positive rate of 5 %. The resulting false negative rate would be dramatically increased.

5.1.3.2 Verification resampling allows sequential application of a much smaller prediction limit, therefore minimizing both false positive and false negative rates.

5.1.3.3 A statistically significant exceedance is not declared and should not be reported until the results of the verification resample are known. The probability of an initial exceedance is much higher than 5 % for the site as a whole.

5.1.3.4 Note that in the parametric case requiring passage of two verification resamples (for example, in the state of California regulation) will lead to higher false negative rates (for a fixed false positive rate) because larger prediction limits are required to achieve a site-wide false positive rate of 5 % than for a single verification resample; hence, the preferred methods are pass one verification resample or pass one of two verification resamples. Also note that nonparametric limits requiring

³ Note, if background detection frequency is zero, one should question whether the analyte is a useful indicator of contamination. If it is not, statistical testing of the constituent should not be performed.

⁴ Some examples of inaccessible or nonrepresentative background upgradient wells may include slow moving ground water, radial or convergent flow, or sites that straddle ground-water divides.

TABLE 1 Probability That the First Sample or the Verification Resample Will Be Below the Maximum of n Background Measurements at Each of k Monitoring Wells for a Single Constituent

Previous n	Number of Monitoring Wells (k)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4	0.933	0.881	0.838	0.802	0.771	0.744	0.720	0.698	0.679	0.661	0.645	0.630	0.617	0.604	0.592
5	0.952	0.913	0.879	0.849	0.823	0.800	0.779	0.760	0.742	0.726	0.711	0.697	0.684	0.672	0.661
6	0.964	0.933	0.906	0.882	0.860	0.840	0.822	0.805	0.789	0.774	0.761	0.748	0.736	0.725	0.714
7	0.972	0.947	0.925	0.905	0.886	0.869	0.853	0.838	0.825	0.812	0.799	0.788	0.777	0.766	0.757
8	0.978	0.958	0.939	0.922	0.906	0.891	0.878	0.864	0.852	0.841	0.830	0.819	0.809	0.800	0.791
9	0.982	0.965	0.949	0.935	0.921	0.908	0.896	0.885	0.874	0.864	0.854	0.844	0.835	0.827	0.818
10	0.985	0.971	0.957	0.945	0.933	0.922	0.911	0.901	0.891	0.882	0.873	0.865	0.857	0.849	0.841
11	0.987	0.975	0.964	0.953	0.942	0.933	0.923	0.914	0.906	0.897	0.889	0.882	0.874	0.867	0.860
12	0.989	0.979	0.969	0.959	0.950	0.941	0.933	0.925	0.917	0.910	0.902	0.896	0.889	0.882	0.876
13	0.990	0.981	0.973	0.964	0.956	0.948	0.941	0.934	0.927	0.920	0.914	0.907	0.901	0.895	0.889
14	0.992	0.984	0.976	0.969	0.961	0.954	0.948	0.941	0.935	0.929	0.923	0.917	0.912	0.906	0.901
15	0.993	0.986	0.979	0.972	0.966	0.959	0.953	0.947	0.942	0.936	0.931	0.926	0.920	0.915	0.910
16	0.993	0.987	0.981	0.975	0.969	0.964	0.958	0.953	0.948	0.943	0.938	0.933	0.928	0.923	0.919
17	0.994	0.988	0.983	0.978	0.972	0.967	0.962	0.957	0.953	0.948	0.943	0.939	0.935	0.930	0.926
18	0.995	0.990	0.985	0.980	0.975	0.970	0.966	0.961	0.957	0.953	0.949	0.944	0.940	0.937	0.933
19	0.995	0.991	0.986	0.982	0.977	0.973	0.969	0.965	0.961	0.957	0.953	0.949	0.946	0.942	0.938
20	0.996	0.991	0.987	0.983	0.979	0.975	0.972	0.968	0.964	0.960	0.957	0.953	0.950	0.947	0.943
25	0.997	0.994	0.992	0.989	0.986	0.984	0.981	0.978	0.976	0.973	0.971	0.968	0.966	0.964	0.961
30	0.998	0.996	0.994	0.992	0.990	0.988	0.986	0.984	0.983	0.981	0.979	0.977	0.975	0.974	0.972
35	0.998	0.997	0.996	0.994	0.993	0.991	0.990	0.988	0.987	0.986	0.984	0.983	0.981	0.980	0.979
40	0.999	0.998	0.997	0.995	0.994	0.993	0.992	0.991	0.990	0.989	0.988	0.987	0.985	0.984	0.983
45	0.999	0.998	0.997	0.996	0.995	0.995	0.994	0.993	0.992	0.991	0.990	0.989	0.988	0.987	0.987
50	0.999	0.998	0.998	0.997	0.996	0.996	0.995	0.994	0.993	0.993	0.992	0.991	0.990	0.990	0.989
60	0.999	0.999	0.998	0.998	0.997	0.997	0.996	0.996	0.995	0.995	0.994	0.994	0.993	0.993	0.992
70	1.00	0.999	0.999	0.998	0.998	0.998	0.997	0.997	0.997	0.996	0.996	0.995	0.995	0.995	0.994
80	1.00	0.999	0.999	0.999	0.999	0.998	0.998	0.998	0.997	0.997	0.997	0.996	0.996	0.996	0.996
90	1.00	1.00	0.999	0.999	0.999	0.999	0.998	0.998	0.998	0.998	0.997	0.997	0.997	0.997	0.996
100	1.00	1.00	0.999	0.999	0.999	0.999	0.999	0.999	0.998	0.998	0.998	0.998	0.997	0.997	0.997

Previous n	Number of Monitoring Wells (k)														
	20	25	30	35	40	45	50	55	60	65	70	75	80	90	100
4	0.542	0.504	0.474	0.449	0.428	0.410	0.394	0.380	0.367	0.356	0.345	0.336	0.327	0.312	0.299
5	0.612	0.574	0.543	0.517	0.495	0.476	0.459	0.443	0.430	0.417	0.406	0.396	0.386	0.369	0.355
6	0.668	0.631	0.600	0.574	0.552	0.532	0.514	0.499	0.484	0.472	0.460	0.449	0.439	0.420	0.405
7	0.713	0.678	0.648	0.623	0.600	0.580	0.563	0.547	0.532	0.519	0.507	0.496	0.485	0.466	0.450
8	0.750	0.717	0.688	0.664	0.642	0.622	0.605	0.589	0.574	0.561	0.549	0.537	0.527	0.507	0.490
9	0.781	0.750	0.723	0.699	0.678	0.659	0.642	0.626	0.612	0.598	0.586	0.574	0.564	0.544	0.527
10	0.807	0.777	0.752	0.729	0.709	0.691	0.674	0.659	0.644	0.631	0.619	0.608	0.597	0.578	0.560
11	0.828	0.801	0.777	0.755	0.736	0.718	0.702	0.687	0.674	0.661	0.649	0.638	0.627	0.608	0.590
12	0.847	0.821	0.799	0.778	0.760	0.743	0.727	0.713	0.700	0.687	0.675	0.664	0.654	0.635	0.618
13	0.862	0.839	0.817	0.798	0.781	0.764	0.750	0.736	0.723	0.711	0.699	0.689	0.678	0.660	0.643
14	0.876	0.854	0.834	0.816	0.799	0.784	0.769	0.756	0.744	0.732	0.721	0.710	0.701	0.682	0.666
15	0.888	0.867	0.848	0.831	0.815	0.801	0.787	0.774	0.762	0.751	0.740	0.730	0.721	0.703	0.686
16	0.898	0.879	0.861	0.845	0.830	0.816	0.803	0.791	0.779	0.768	0.758	0.748	0.739	0.722	0.706
17	0.907	0.889	0.872	0.857	0.843	0.830	0.817	0.806	0.794	0.784	0.774	0.765	0.756	0.739	0.723
18	0.914	0.896	0.882	0.868	0.855	0.842	0.830	0.819	0.808	0.798	0.789	0.780	0.771	0.754	0.739
19	0.921	0.906	0.891	0.878	0.865	0.853	0.842	0.831	0.821	0.811	0.802	0.793	0.785	0.769	0.754
20	0.928	0.913	0.899	0.886	0.874	0.863	0.852	0.842	0.832	0.823	0.814	0.806	0.798	0.782	0.768
25	0.950	0.939	0.929	0.919	0.910	0.901	0.892	0.884	0.876	0.869	0.862	0.855	0.848	0.835	0.823
30	0.963	0.955	0.947	0.940	0.932	0.925	0.919	0.912	0.906	0.900	0.894	0.888	0.882	0.872	0.861
35	0.972	0.966	0.959	0.954	0.948	0.942	0.937	0.931	0.926	0.921	0.916	0.911	0.907	0.898	0.889
40	0.978	0.973	0.968	0.963	0.958	0.954	0.949	0.945	0.941	0.936	0.932	0.928	0.924	0.917	0.909
45	0.982	0.978	0.974	0.970	0.966	0.962	0.959	0.955	0.951	0.948	0.944	0.941	0.938	0.931	0.925
50	0.985	0.982	0.979	0.975	0.972	0.969	0.966	0.963	0.959	0.956	0.954	0.951	0.948	0.942	0.937
60	0.990	0.987	0.985	0.982	0.980	0.978	0.975	0.973	0.971	0.968	0.966	0.964	0.962	0.958	0.954
70	0.992	0.990	0.989	0.987	0.985	0.983	0.981	0.980	0.978	0.976	0.974	0.973	0.971	0.968	0.965
80	0.994	0.993	0.991	0.990	0.988	0.987	0.986	0.984	0.983	0.981	0.980	0.979	0.977	0.975	0.972
90	0.995	0.994	0.993	0.992	0.991	0.990	0.988	0.987	0.986	0.985	0.984	0.983	0.982	0.980	0.978
100	0.996	0.995	0.994	0.993	0.992	0.991	0.991	0.990	0.989	0.988	0.987	0.986	0.985	0.983	0.982

passage of two verification resamples will result in need for a larger number of background samples than are typically available (see 6.3.3.1) (1).

5.1.4 False Positive and False Negative Rates:

5.1.4.1 Conduct simulation study based on current monitoring network, constituents, detection frequencies, and distributional form of each monitoring constituent (see Appendix B of Ref (4)). The specific objectives of the simulation study are to determine if the false positive and false negative rates of the

current monitoring program as a whole are acceptable and to determine if changes in verification resampling plans or choice of nonparametric versus Poisson prediction limits or inter-well versus intra-well comparison strategies will improve the overall performance of the detection monitoring program.

5.1.4.2 Project frequency of which verification resamples will be required and false assessments for site as a whole for each monitoring event based on the results of the simulation study. In this way the owner/operator will be able to anticipate

the required amount of future sampling.

5.1.4.3 As a general guideline, a site-wide false positive rate of 5 % and a false negative rate of approximately 5 % for differences on the order of three to four standard deviation units are recommended. Note that USEPA recommends simulating the most conservative case of a release that effects a single constituent in a single downgradient well. In practice, multiple constituents in multiple wells will be impacted, therefore, the actual false negative rates may be considerably smaller than estimates obtained by means of simulation.

5.1.5 Use of DLs and QLs in Ground-Water Monitoring:

5.1.5.1 The DLs indicate that the analyte is present in the sample with confidence.

5.1.5.2 The QLs indicate that the true quantitative value of the analyte is close to the measured value.

5.1.5.3 For analytes with estimated concentration exceeding the DL but not the QL, it can be concluded that the true concentration is greater than zero; however, uncertainty in the instrument response is by definition too large to make a reliable quantitative determination. Note that in a qualitative sense, values between the DL and QL are greater than values below the DL, and this rank ordering can be used in a nonparametric method.

5.1.5.4 If the laboratory-specific DL for a given compound is 3 µg/L, and the QL for the same compound is 6 µg/L, then a detection of that compound at 4 µg/L could actually represent a true concentration of anywhere between 0 and 6 µg/L. The true concentration may well be less than the DL (1,2,11).

5.1.5.5 Direct comparison of a single value to a maximum concentration level (MCL), or any other concentration limit, is not adequate to demonstrate noncompliance unless the concentration is larger than the QL.

5.1.5.6 Verification resampling applies to this case as well.

6. Report

6.1 This section provides a description of the specific statistical methods referred to in this guide. Note that specific recommendations for any given facility require an interdisciplinary site-specific study that encompasses knowledge of the facility, its hydrogeology, geochemistry, and study of the false positive and false negative error rates that will result. Performing a correct statistical analysis, such as nonparametric prediction limits, in the wrong situation (for example, when there are too few background measurements) can lead to erroneous conclusions.

6.2 Upgradient Versus Downgradient Comparisons:

6.2.1 Case One—Compounds Quantified in All Background Samples:

6.2.1.1 Test normality of distribution using the multiple group version of the Shapiro-Wilk test applied to n background measurements (12). The multiple group version of the Shapiro-Wilk test takes into consideration that background measurements are nested within different background monitoring wells, hence the original Shapiro-Wilk test does not directly apply.

NOTE 2—Background wells used for inter-well comparisons may in some cases include wells that are not hydraulically upgradient of the site.

6.2.1.2 Alternatively, residuals from the mean of each upgradient well can be pooled together and tested using the

single group version of the Shapiro-Wilk test (13).

6.2.1.3 The need for a multiple group test to incorporate spatial variability among upgradient wells also raises the question of validity of upgradient versus downgradient comparisons. Where significant spatial variability exists, it may not be possible to obtain a representative upgradient background, and intra-well comparisons may be required. A one-way analysis of variance (ANOVA) applied to the upgradient well data provides a good way of testing for significant spatial variability.

6.2.1.4 If normality is not rejected, compute the 95 % prediction limit as follows:

$$\bar{x} + t_{(n-1, \alpha)}^* \sqrt{1 + \frac{1}{n}} \quad (1)$$

where:

$$\bar{x} = \sum_{i=1}^n \frac{x_i}{n} \quad (2)$$

$$s = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n - 1}} \quad (3)$$

α = false positive rate for each individual test,

$t_{(n-1, \alpha)}^*$ = one-sided $(1 - \alpha)$ 100 % point of Student's t distribution on $n - 1$ df, and

n = number of background measurements. Select α as the minimum of 0.01 or one of the following:

(1) Pass the first or one of one verification resample:

$$\alpha = (1 - 0.95^{1/k})^{1/2} \quad (4)$$

(2) Pass the first or one of two verification resamples:

$$\alpha = (1 - 0.95^{1/k})^{1/3} \quad (5)$$

(3) Pass the first or two of two verification resamples:

$$\alpha = \sqrt{1 - 0.95^{1/k}} \sqrt{1/2} \quad (6)$$

where:

k = number of comparisons (that is, monitoring wells times constituents (see section 5.2.2 of Ref (4)).

6.2.1.5 Note that these formulas for computing the adjusted individual comparison α all ignore two sources of dependence: comparisons for a given constituent are all made against the same background and concentrations of the indicator constituents may be positively correlated over time. Solution of the first problem has been provided by Refs (1) and (14) and has provided detailed tabulation of factors that can be used in computing the exact prediction limits. In terms of the second problem, constituents that are highly correlated (based on pairwise correlations) could be eliminated, not from the statistical analysis, but from the total set of comparisons used to compute α , leading to more powerful and realistic prediction limits.

6.2.1.6 If normality is rejected, take natural logarithms of the n background measurements and recompute the multiple group Shapiro-Wilk test.

6.2.1.7 If the transformation results in a nonsignificant G statistic (that is, the values $\log_e(x)$ are normally distributed compute the lognormal prediction limit as follows:

$$\exp\left(y + t_{(n-1, \alpha)} s_y \sqrt{1 + \frac{1}{n}}\right) \quad (7)$$

where:

$$y = \sum_{i=1}^n \frac{\log_e(x_i)}{n} \quad (8)$$

and:

$$s_y = \sqrt{\frac{\sum_{i=1}^n (\log_e(x_i) - y)^2}{n-1}} \quad (9)$$

6.2.1.8 If log transformation does not bring about normality (that is, the probability of G is less than 0.01), compute nonparametric prediction limits (Option—Compute normal prediction limit).

6.2.2 *Case Two—Compounds Quantified in at Least 50 % of All Background Samples:*

6.2.2.1 Apply the multiple group Shapiro-Wilk test to the n_1 quantified measurements only.

6.2.2.2 If the data are normally distributed compute the mean of the n background samples as follows:

$$\bar{x} = \left(1 - \frac{n_0}{n}\right) \bar{x}' \quad (10)$$

where:

\bar{x}' = average of the n_1 detected values, and

n_0 = number of samples in which the compound is not detected. The standard deviation is:

$$s = \sqrt{\left(1 - \frac{n_0}{n}\right) s'^2 + \frac{n_0}{n} \left(1 - \frac{n_0-1}{n-1}\right) \bar{x}'^2} \quad (11)$$

where s' is the standard deviation of the n_1 detected measurements. The normal prediction limit can then be computed as previously described. This method is due to Aitchison (see 2.2.2 of Ref (4) and (15)). Note that this method imputes nondetects as zero concentrations.

6.2.2.3 A good alternative to Aitchison's method is Cohen's maximum likelihood estimator (16). Extensive tables and computational details are also provided in Gibbons, 1991. A useful approach to selecting between the two methods is described in 2.2.1 of Ref (4).

6.2.2.4 If the multiple group Shapiro-Wilk test reveals that the data are lognormally distributed, replace \bar{x}' with \bar{y}' and s' and s_y in the equations for \bar{x} and s . The lognormal prediction limit may then be computed as previously described.

NOTE 3—This adjustment only applies to positive random variables. The natural logarithm of concentration less than 1 are negative and therefore the adjustment does not apply. For this reason we add 1 to each value (for example, $\log_e(x_i + 1) \geq 0$), compute the prediction limit on a log scale and then subtract one from the antilog of the prediction limit.

6.2.2.5 If the data are neither normally or lognormally distributed, compute a nonparametric prediction limit. (Option—compute normal prediction limit).

6.2.3 *Case Three—Compounds Quantified in Less Than 50 % of All Background Samples:*

6.2.3.1 In this application, the nonparametric prediction limit is the largest concentration found in n upgradient measurements (see section 4.2.1 of Ref (8)).

6.2.3.2 Gibbons (18,19) has shown that the confidence associated with this decision rule, following one or more

verification resamples, is a function of the multivariate extension of the hypergeometric distribution (see section 5.2.3 of Ref (8)).

6.2.3.3 Complete tabulations of confidence levels for $n = 4, \dots, 100, k = 1, \dots, 100$ future comparisons (for example, monitoring wells), and a variety of verification resampling plans are presented in (1). For example with five monitoring wells and ten constituents (that is, 50 comparisons), 40 background measurements would be required to provide 95 % confidence (see section 5.2.3 of Ref (4)). Table 1 displays confidence levels for a single verification resample.

6.2.3.4 As an option to the nonparametric prediction limits, compute Poisson prediction limits. Poisson prediction limits are useful for those cases in which there are too few background measurements to achieve an adequate site-wide false positive rate using the nonparametric approach. Gibbons (19) derived the original Poisson prediction limit. Cameron (20) found that use of a normal multiplier in place of Student's t -distribution resulted in a more powerful test, thus the Poisson prediction limit is:

$$\text{Poisson PL} = y/n - \frac{z^2}{2n} + z/n \sqrt{y(1+n) + z^2/4} \quad (12)$$

where y is the sum of the detected measurements or the quantification limit for those samples in which the constituent was not detected, and z is the $(1 - \alpha)$ 100 upper percentage point of the normal distribution, where α is computed as in 6.2.1.4.

NOTE 4—If the Poisson prediction unit is less than the quantification limit, recompute the prediction limit substituting the quantification limit for the nondetects.

6.3 Intra-Well Comparisons:

6.3.1 One particularly good method for computing intra-well comparisons is the combined Shewart-CUSUM control chart (see 6.1 in Ref (4)). The method is sensitive to both gradual and rapid releases and is also useful as a method of detecting "trends" in data. Note that this method should be used on wells unaffected by the landfill. There are several approaches to implementing the method, and in the following, one useful way is described as well as discussion of some statistical properties.

6.3.2 Assumptions:

6.3.2.1 The combined Shewart-CUSUM control chart procedure assumes that the data are independent and normally distributed with a fixed mean μ and constant variance σ^2 . The most important assumption is independence, and as a result, wells should be sampled no more frequently than quarterly. In some cases, where ground water moves relatively quickly, it may be possible to accelerate background sampling to eight samples in a single year; however, this should only be done to establish background and not for routine monitoring. The assumption of normality is somewhat less of a concern, and if problematic, natural log or square root transformation of the observed data should be adequate for most practical applications. For this method, nondetects can be replaced by the quantification limit without serious consequence. This procedure should only be applied to those constituents that are

detected at least in 25 % of all samples, otherwise, σ^2 is not adequately defined.

6.3.2.2 When large intra-well background databases are available, (for example, three years or more of at least semiannual monitoring) obvious cyclic or trend patterns can be removed from both the baseline data and from the future data to be plotted on the chart. Similarly, when the background database consists of eight or more background measurements, use of Aitchison's (15) or Cohen's (16) methods for computing the background mean and standard deviation can be used in place of simple imputation of the quantification limit.

6.3.3 Nondetects:

6.3.3.1 For those well and constituent combinations in which the detection frequency is less than 25 %, the data should be displayed graphically until a sufficient number of measurements are available to provide 99 % confidence (that is, 1 % false positive rate) for an individual well and constituent using a nonparametric prediction limit, which in this context is the maximum detected value out of the n historical measurements. As previously discussed this amounts to 13 background samples for 1 resample, 8 background samples for pass 1 of 2 resamples and 18 background samples for pass 2 of 2 resamples. If nonparametric prediction limits are to be used for intra-well comparisons of rarely detected constituents, 2 verification resamples will often be required, and failure will only be indicated if both measurements exceed the limit (that is, the maximum of the first 8 samples).

6.3.3.2 Note that these background sample sizes provide 99 % confidence for a single future comparison and not all of the wells and constituents for which they will actually be applied. Adjustment for multiple comparisons will require even larger background sample sizes that may not be possible to obtain at most facilities. In light of this, the recommendations in 6.3.3.1 provide a minimum requirement.

6.3.3.3 For those cases in which the detection frequency is greater than 25 %, substitute the QL (or where there are multiple QLs, the median QL) for the nondetects. In this way, changes in quantification limits do not appear to be significant trends.

6.3.3.4 If nothing is detected in 8, 13, or 18 independent samples (depending on resampling strategy), use the quantification limit as the nonparametric prediction limit.

6.3.3.5 As in the previously described inter-well comparisons, optional use of Poisson prediction limits as an alternative to nonparametric prediction limits for rarely detected constituents (that is, less than 25 % detects) is recommended when the number of background measurements is small. Poisson prediction limits can be computed after eight background measurements regardless of detection frequency.

6.3.4 Procedure:

6.3.4.1 Require that at least eight historical independent samples are available to provide reliable estimates of the mean μ and standard deviation σ , of the constituent's concentration in each well.

6.3.4.2 Select the three Shewart-CUSUM parameters, h , (the value against which the cumulative sum will be compared), c (a parameter related to the displacement that should be quickly detected), and SCL (the upper Shewart limit that is

the number of standard deviation units for an immediate release). Lucas (21) and Starks (22) suggest that $c = 1$, $h = 5$, and $SCL = 4.5$ are most appropriate for ground-water monitoring applications. This sentiment is echoed by USEPA in their interim final guidance document (23).

6.3.4.3 Denote the new measurement at time-point t_i as x_i and compute the standardized value z_i :

$$z_i = \frac{x_i - \bar{x}}{s} \quad (13)$$

where \bar{x} and s are the mean and standard deviation of at least eight historical measurements for that well and constituent (collected in a period of no less than one year).

6.3.4.4 At each time period, t_i , compute the cumulative sum S_i , as:

$$S_i = \max [0, (z_i - c) + S_{i-1}] \quad (14)$$

where: $\max[A, B]$ is the maximum of A and B , starting with $S_0 = 0$.

6.3.4.5 Plot the values of S_i (y-axis) versus t_i (x-axis) on a time chart. Declare an "out-of-control" situation on sampling period t_i if for the first time, $S_i \geq h$ or $z_i \geq SCL$. Any such designation, however, must be verified on the next round of sampling, before further investigation is indicated.

6.3.4.6 The reader should note that unlike prediction limits that provide a fixed confidence level (for example, 95 %) for a given number of future comparisons, control charts do not provide explicit confidence levels, and do not adjust for the number of future comparisons. The selection of $h = 5$, $SCL = 4.5$ and $c = 1$ is based on USEPA's own review of the literature and simulations 21,22, and 23). The USEPA indicates that these values "allow a displacement of two standard deviations to be detected quickly." Since 1.96 standard deviation units corresponds to 95 % confidence on a normal distribution, we can have approximately 95 % confidence for this test method as well. In practice, setting $h = SCL = 4.5$ results in a single limit with no compromise in leak detection capabilities.

6.3.4.7 In terms of plotting the results, it is more intuitive to plot values in their original metric (for example, microgram per litre) rather than in standard deviation units. In this case, $h = SCL = \bar{x} + 4.5s$, and the S_i are converted to the concentration metric by the transformation $S_i^* s + \bar{x}$, noting that when normalized (that is, in standard deviation units) $\bar{x} = 0$ and $s = 1$ so that $h = SCL = 4.5$ and $S_i^* 1 + 0 = S_i$. Note that when $n \geq 12$ recompute the mean and standard deviation and adjust the control limits $h = SCL = 4.0$ and $c = 0.75$.

6.3.5 Outliers:

6.3.5.1 From time to time, inconsistently large or small values (outliers) can be observed due to sampling, laboratory, transportation, transcription errors, or even by chance alone. Verification resampling will tremendously reduce the probability of concluding that an impact has occurred if such an anomalous value is obtained for any of these reasons. However, nothing has eliminated the chance that such errors might be included in the historical measurements for a particular well and constituent. If such erroneous values (either too high or too low) are included in the historical database, the result would be

an artificial increase in the magnitude of the control limit, and a corresponding increase in the false negative rate of the statistical test (that is, conclude that there is no site impact when in fact there is).

6.3.5.2 To remove the possibility of this type of error, the historical data are screened for each well and constituent for the existence of outliers (see 6.2 in Ref (4)) using the well-known method described by Dixon (24). These outlying data points are indicated on the control charts (using a different symbol), but are excluded from the measurements that are used to compute the background mean and standard deviation. In the future, new measurements that turn out to be outliers, in that they exceed the control limit, will be dealt with by verification resampling in downgradient wells only.

6.3.5.3 This same outlier detection algorithm is applied to each upgradient well and constituent to screen outliers for inter-well comparisons as well.

6.3.6 Existing Trends:

6.3.6.1 If contamination is preexisting, trends will often be observed in the background database from which the mean and variance are computed. This will lead to upward biased estimates and grossly inflated control limits. To remove this possibility, first screen the background data for each well and constituent for trend using Sen's nonparametric estimate of trend (25). Confidence limits for this trend estimate are given by Gilbert (26). A significant trend is one in which the 99 % lower confidence bound is greater than zero. In this way, even preexisting trends in the background dataset will be detected.

6.3.6.2 When significant trends in background are found, their source must be identified prior to continuation of detection monitoring since they may be evidence of a prior site impact. If the source of the trend is found to be unrelated to the facility, then an alternative indicator constituent may be required for that well or all wells at the facility.

6.3.7 Note on Verification Sampling:

6.3.7.1 It should be noted that when a new monitoring value is an outlier, perhaps due to a transcription error, sampling error, or analytical error, the Shewart and CUSUM portions of the control chart are affected quite differently. The Shewart portion of the control chart compares each individual new measurement to the control limit, therefore, the next monitoring event measurement constitutes an independent verification of the original result. In contrast, however, the CUSUM procedure incorporates all historical values in the computation, therefore, the effect of the outlier will be present for both the initial and verification sample: hence the statistical test will be invalid.

6.3.7.2 For example, assume $\bar{x} = 50$ and $s = 10$. On Quarter 1 the new monitoring value is 50, so $z = (50 - 50)/10 = 0$ and $S_i = \max[0, (z - 1) + 0] = 0$. On Quarter 2, a sampling error occurs (that is, documented as an error after review of chain of custody) and the reported value is 200, yielding $z = (200 - 50)/10 = 15$ and $S_i = \max[0, (15 - 1) + 0] = 14$, that is considerably larger than 4.5; hence an initial exceedance is recorded. On the next round of sampling, the previous result is not confirmed, because the result is back to 50. Inspection of the CUSUM, however, yields $z = (50 - 50)/10 = 0$ and $S_i = \max[0, (0 - 1) + 14] = 13$, that

would be taken as a confirmation of the exceedance, when in fact, no such confirmation was observed. For this reason, the verification must replace the suspected result in order to have an unbiased confirmation.

6.3.8 *Updating the Control Chart*—As monitoring continues and the process is shown to be in control, the background mean and variance should be updated periodically to incorporate these new data. Every year or two, all new data that are in control should be pooled with the initial samples and \bar{x} and s recomputed. These new values of \bar{x} and s will then be used in constructing future control charts. This updating process should continue for the life of the facility or monitoring program, or both (see 6.1 in Ref (8)).

6.3.9 *An Alternative Based on Prediction Limits*—An alternative approach to intra-well comparisons involves computation of well-specific prediction limits. Prediction limits are somewhat more sensitive to immediate releases but less sensitive to gradual releases than the combined Shewart-CUSUM control charts. Prediction limits are also less robust to deviations from distributional assumptions (1).

7. Restriction of Background Samples

7.1 Certain states have interpreted the regulations as indicating that background be confined to the first four samples collected in a day or a semiannual monitoring event or a year. This conflicts with federal regulation and guidance. The first approach (that is, four samples in a day) violates the assumption of independence and confounds day to day temporal and seasonal variability with potential contamination. As an analogy, consider setting limits on yearly ambient temperatures in Chicago by taking four temperature readings on July 4th. On that day the temperature varied between 78 and 82°F (26 and 28°C) yielding a prediction interval from 70 to 90°F (21 to 32°C). In January, the temperature in Chicago can be -20°F (-28°C). Clearly, in this example restriction of background leads to nonrepresentative prediction of future measurements. In the second approach restricting establishment of background to the first four events taken in six months underestimates the component of seasonal variability and can lead to elevated false positive or false negative rates. The net result is that comparisons of background water quality in the summer may not be representative of downgradient ground-water quality in the winter (for example, disposal of road salts increasing specific conductivity in the winter). In the third approach in which background is restricted to the first four quarterly measurements, independence is typically not an issue and background versus point of compliance monitoring well comparisons are not confounded with season for that year, however, background from this year may not reflect temporal variability in future years (for example, a drought condition). In addition, as previously pointed out in the temperature illustration, restriction of background to only four samples dramatically increases the size of the statistical prediction limit thereby increasing the false negative rate of the test (that is, the prediction limit is over five standard deviation units above the background mean concentration). The reason for this is that the uncertainty in the true mean concentration covers the majority of the normal distribution. As such, virtually any mean and standard deviation could be obtained by chance alone. If by

chance the values are low, false positive results will occur. If by chance the values are high, false negative results will occur. By increasing the background sample size, uncertainty in the sample-based mean and standard deviation decrease as does the size of the prediction limit, therefore both false positive and false negative rates are minimized.

7.2 In light of these considerations, it is always in the best interest to have the largest available background database consisting of independent and representative measurements. Two possible strategies used to obtain a larger background

database are add background wells to the monitoring system (this also facilitates characterization of spatial variability) and update the background database at appropriate intervals (that is, either continuously for inter-well or every year or two for intra-well) with new measurements that are determined to belong to the same background population.

8. Keywords

8.1 control charts; detection monitoring; ground water; prediction limits; statistics; waste disposal facilities

REFERENCES

- (1) Gibbons, R. D., *Statistical Methods for Ground-Water Monitoring*, John Wiley & Sons, 1994.
- (2) Currie, *Analytical Chemistry*, 40, 1968, pp. 586-593.
- (3) Koorse, *Environmental Law Reporter*, 19, 1989, pp. 10211-10222.
- (4) USEPA, "Addendum to Interim Final Guidance Document," *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities*, July, 1992.
- (5) USEPA 40CFR Part 264: "Statistical Methods for Evaluating Ground-Water Monitoring from Hazardous Waste Facilities; Final Rule," *Federal Register*, 53, 196, 1988, pp. 39720-39731.
- (6) USEPA 40CFR 258.53(h)(2).
- (7) USEPA 40CFR 258.53(h)(1).
- (8) USEPA 40CFR 258.53(h)(5).
- (9) USEPA 40CFR 258.53(h)(3).
- (10) USEPA 40CFR 258.55.
- (11) Hubaux, A., and Vos, G., *Analytical Chemistry*, 42, 1970, pp. 849-855.
- (12) Wilk, M. B., and Shapiro, S. S., *Technometrics*, 10, No. 4, 1968, pp. 825-839.
- (13) Shapiro, S. S., and Wilk, M. B., *Biometrika*, 52, 1965, pp. 591-611.
- (14) Davis, C. B. and McNichols, R. J., *Technometrics*, 29, 1987, pp. 359-370.
- (15) Aitchison, J., *Journal of the American Statistical Association*, 50, 1955, pp. 901-908.
- (16) Cohen, A. C., *Technometrics*, 3, 1961, pp. 535-541.
- (17) Gibbons, R. D., *Ground Water*, 28, 1990, pp. 235-243.
- (18) Gibbons, R. D., *Ground Water*, 29, 1991, pp. 729-736.
- (19) Gibbons, R. D., *Ground Water*, 25, 1987, pp. 572-580.
- (20) Cameroo, K., (1995) EPA/530-R-93-003.
- (21) Lucas, J. M., *Journal of Quality Technology*, 14, 1982, pp. 51-59.
- (22) Starks, T. H., "Evaluation of Control Chart Methodologies for RCRA Waste Sites," *USEPA Technical Report CR814342-01-3*, 1988.
- (23) *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities*, 1989.
- (24) *Biometrika*, 9, 1953, pp. 74-89.
- (25) Sen, P. K., *Journal of the American Statistical Association*, 63, 1968, pp. 1379-1389.
- (26) Gilbert, R. O., *Statistical Methods for Environmental Pollution Monitoring*, Van Nostrand Reinhold, New York, 1987.

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 100 Barr Harbor Drive, West Conshohocken, PA 19428.